Say it aloud: Measuring change talk and user perceptions in an automated, technology-delivered adaptation of motivational interviewing delivered by video-counsellor

Joana Galvão Gomes da Silva[a], David J. Kavanagh[b], Jon May[a], Jackie Andrade[a,*]

[a] School of Psychology, University of Plymouth, Plymouth PL4 8AA, UK
[b] School of Psychology and Counselling, Queensland University of Technology, Brisbane, Australia

ABSTRACT

Motivational Interviewing is a widely used counselling technique. A fundamental principle of this technique is that hearing oneself argue for change strengthens motivation. This study presents the first analysis of participants' dialogue with an automated motivational interviewer. The objective was to explore communication with, and perceptions of, a technology-delivered adaptation of motivational interviewing (TAMI) delivered by a pre-recorded video-counsellor. Eighteen participants undertook the video interview and evaluated it after one week. Interviews were scored for change and sustain talk. Participants' written evaluations were subjected to thematic analysis. Interviews lasted 10 min 30 s (SD 3 min 0 s). Change talk was observed in a mean of 16 of 25 responses (SD 3.35, range 11–21). Sustain talk was less frequent (mean = 3.4 replies, SD = 2.5, range 0 to 8). Participants disliked seeing their own image in the webcam and desired a personalised interaction where each question depended on the answer given to the previous one. Positive appraisals included space to think about motivation and plans, and hearing themselves voicing goals. A brief, generic, automated TAMI elicited change talk and was perceived as motivating.

1. Introduction

Motivational Interviewing (MI) (Miller and Rollnick, 2012) is a widely used brief intervention to support motivation (Lundahl et al., 2010; Rubak et al., 2005). It is a person-centred counselling technique, where the interviewer collaborates with the interviewee to elicit their own motivations and confidence for change, using reflective listening to amplify their emotional impact. MI is effective for behaviour change in a range of domains (Burke et al., 2003), including managing weight (Armstrong et al., 2011), reducing alcohol (Vasilaki and Hosier, 2006), and increasing physical activity (O'Halloran et al., 2014). Many people who might benefit from motivational support are unable to access it (Booth et al., 2015). If MI could be automated and delivered remotely, it could help motivate the behaviour changes needed to reduce so-called lifestyle diseases such as diabetes and heart disease. Previous efforts at doing this have omitted a key feature of MI, that it is a collaborative spoken dialogue. As a building block towards developing a fully functional automated system for motivational interviewing, we report the development of an automated adaptation of a motivational interview delivered via computer that, for the first time, encourages the participant to engage in an out-loud 'dialogue' with a pre-recorded video-counsellor. This study comprises initial user testing aimed at establishing key markers of success: that participants should engage with the intervention and experience it as motivating, and that it should encourage them to talk aloud about changing their behaviour. Achieving these outcomes will provide a basic model into which advances in speech recognition can be incorporated, and a method for evaluating such advances.

It might be argued that face-to-face or at least "live" interactions are essential for delivering the empathetic, responsive, person-centred counselling that is the heart of MI, but in fact it has been translated into virtual delivery with some success. Shingleton and Palfai (2016) systematically reviewed technology-delivered adaptations of MI (TAMIs) for health-related behaviours. Thirty-two studies delivered fully-automated motivational interviewing interventions with no therapist/expert interaction, using emoticons, virtual 'buddies', or talking narrators to

simulate discourse with a therapist. Although most of the studies only included a subset of MI features, TAMIs did help change behaviour.

Several studies have employed video clips in their TAMIs but often only to provide an introduction or education (e.g., Ahmedani et al., 2015; Alemagno et al., 2009; Budney et al., 2011; Friederichs et al., 2014; Osilla et al., 2012; Wagener et al., 2012). Gerbert et al. (2003) developed a more interactive Video Doctor system using branching logic and a library of video clips to create a tailored interaction. The Video Doctor asks questions and the client replies by choosing from answers shown on the screen. Their choice determines the program's selection of the next video clip. Results have been encouraging. In a large trial of HIV-positive patients, Gilbert et al., (2008), found that the Video Doctor reduced illicit drug use and unprotected sex. A randomised controlled trial with pregnant women showed a reduction in cigarettes smoked per day for smokers who completed the Video Doctor program ($p = .05$) (Tsoh et al., 2010); effects on abstinence were promising but not statistically significant, probably because this part of the larger Health in Pregnancy trial was underpowered. Another sub-study from the same trial showed improvements in diet and exercise in the Video Doctor condition, though no impact on weight (Jackson et al., 2011). Humphreys et al. (2011) showed that the Video Doctor led to more women to have discussions with the healthcare provider about partner violence.

The Video Doctor program shows the potential to deliver an automated version of MI that impacts behaviour and may have benefits over traditional counselling for encouraging participants to discuss sensitive personal issues (Gerbert et al., 1999). However, outcome data on smoking and weight from the Health in Pregnancy subtrials suggest there is still room for improvement. Key to this improvement might be getting the participant to engage more actively in the MI.

Although previous TAMIs have used avatars to talk to the client, they have generally not required the client to talk back. A key principle in MI is that an individual's motivation will strengthen when they hear themselves articulating their goals, reasons and plans for change. An important aim is to elicit 'change talk', to increase the extent to which the client expresses a need or desire to change, relative to the extent to which they discuss reasons for maintaining their current behaviour ('sustain talk') (Apodaca and Longabaugh, 2009; Magill et al., 2014; Gaume et al., 2016). A recent review found that clients' change talk mediates the impact of MI therapists on health behavioural outcomes (Copeland et al., 2015). The current study tested whether change talk could be elicited during an automated motivational interview that used video interactive technology to encourage participants to communicate verbally with a video-counsellor, mimicking a synchronous interaction within the limitations of current technology.

To our knowledge, only four studies have attempted to get participants to talk to the technology delivering the motivational interview. Kanaoka and Mutlu (2015) encouraged participants to speak to a robot acting as a motivational interviewer. They found that problems in speech recognition and gesturing disrupted participants' illusion of dialogue and there was no benefit of the TAMI. Kahler et al. (2017) asked participants to speak to a computer in a Wizard of Oz scenario, where the computer appeared able to give personalised responses but in reality these responses were selected by a human operator behind the scenes. They found benefits for this speech-based intervention compared to a text-based intervention for reducing alcohol consumption. These findings are consistent with our assumption that speaking aloud to a computer can bring benefits, but that speech recognition software is not yet sufficiently sophisticated to accommodate unconstrained responses by the speaker. In a third, qualitative, study, participants spoke to a robot that followed a fixed script based on MI principles (Galvao Gomes da Silva et al., 2018). They found it motivating to hear themselves speaking aloud about their problems and plans. The novelty of speaking to a robot was also a benefit as it made the interaction memorable. A similar robot interaction with a branching script led to successful behaviour change (Robinson et al., 2020).

None of these studies assessed the quality of the interactions. It remains uncertain whether perceived benefits were due to elicited change talk – in other words, whether the interactions were effective by the same mechanism as MI. We developed a video-counsellor delivering a pre-recorded MI script, where questions appeared in a fixed order rather than using Gerbert et al.'s branching logic. The goal was to provoke the participant to reflect, elaborate, and speak his or her answers to the virtual counsellor. In effect, we were encouraging a conversation with oneself through a virtual medium, which is the video-counsellor. We chose a computer-based video-counsellor rather than a robot because the point of developing technology-based MI is to increase access to counselling, and computers are more available and accessible than robots.

This study makes two innovations: it tests participants' experiences of an automated adaptation of a motivational interview where they speak aloud to a pre-recorded video-counsellor without the intervention of another human, and it tests the quality of the interaction by measuring the extent to which it elicits change talk from participants. We hypothesized that participants would find it motivating to articulate and hear their own incentives and plans for change. We used qualitative methods to test this hypothesis and to explore participants' experiences of using the video-counsellor software, because apps that are too complex or hard to use can sap motivation rather than boost it (Solbrig et al., 2017). We used the definitions in the client behaviour section of the Motivational Interviewing Skill Code (Houck et al., 2010) for scoring participants' speech for change and sustain talk, providing a quantitative analysis of the quality of the interviews. Using this code to score human to human MI requires substantial training to achieve consistency across reviewers (Gill et al., 2020). We adapted it by taking statements at face value, rather than interpreting them in the context of a dynamic dialogue. For ease of recruitment, we focused on motivation to increase physical activity because inactivity is a widespread problem, with only 6% of men and 4% of women in the UK achieving the government's recommendations regarding physical activity (NHS Information Centre, Health Survey for England, 2008).

2. Methods

2.1. Motivational interviewing script

As in (Galvao Gomes da Silva et al., 2018), an intervention script was developed, based on manuals developed for face-to-face motivational interviews in clinical trials (Kavanagh et al., 2016; Solbrig and Andrade, 2016) and using Miller and Rollnick (2002, 2012) books as guides. Care was taken that each question should make sense, regardless of the participant's answer to the preceding question. We iteratively read through the script and role-played different answers to see which follow-up responses by the video-counsellor might work, modifying the script where possible to solve anticipated problems.[1]

We shaped participants' expectations by having the video-counsellor advise them, at the start of the interview, that "During this interview, sometimes I may ask you questions that you think you've already answered. If that happens, I suggest you use it as an opportunity to think about the issue a bit more". We considered questions based on advantages of change and disadvantages of the status quo, optimism about change, intention to change, evocation, hypothetical change, setting goals, and arriving at a plan. The script asked permission to discuss behaviour change, and then developed discrepancy by asking about benefits of change and what may happen in the future if there is no change. There was a focus on feelings and concerns about possible futures, to evoke participants' ideas and values, and to strengthen commitment to change. In face to face MI, the interviewer would use

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[1] Three of the authors had previously been trained in motivational interviewing by members of the Motivational Interviewing Network of Trainers.

Table 1

Authors' characterisation of comprehensiveness of technology-delivered adaptation of motivational interviewing by video-counsellor using Shingleton and Palfai's (2016) schema (3 = good quality, approximating face-to-face MI; 2 = pretty good but not optimal; 1 = present but superficial or inadequate; 0 = not present at all). The full video-counsellor script is provided in Multimedia Appendix A.

Quality of MI components in the TAMI	Ratings (0, 1, 2, 3)	Notes
Develop discrepancy/ explore ambivalence	2	Interview explores positives from change and elicits related feeling, but does not give an opportunity to explore sustaining factors, or consider their relative importance in comparison with advantages of change. It does not explore discrepancy from important values. It could have been done better by linking with core values.
Roll with resistance	0	Not possible in this format without branching logic.
Promote autonomy	1	Interview assumes the person will move to a goal – e.g. after consideration of advantages of change. No autonomy statements included. Interviewees have free choice of which goal and steps they select, but interviewer does not reinforce that they can choose to change or stick with behaviour. The interview is somewhat therapist-centred. "Give it a go" at the end of the self-efficacy section may elicit resistance.
Express empathy	1	Counsellor was selected on basis of seeming empathetic, and the listening part is intended to be perceived as empathetic.
Collaboration	1	Some collaborative language present but could be stronger, e.g., "Is it okay if we talk about that now?", "Let's do this…"
Evocation	3	Strong, e.g., "Why is it important to you?", "Does that worry or concern you. Why?"
Promote self-efficacy	3	Addressed well, e.g., "Let's focus on your confidence in getting started. How confident are you that you can carry out this plan for the next week? Give it a rating from 0, not at all confident, to 100%, really confident."

(*continued on next page*)

Table 1 (*continued*)

Strengthen commitment to change	●	Elicited by getting the participant to articulate/summarise a plan. E.g., "What will you do?" Language about plan gradually becomes more concrete.
Ask permission	◔	Only at start – poor that we are pushing towards a goal.
Reflections and summaries	◑	Video-counsellor cannot reflect but elicits summaries twice. "I suggest you summarise what you are going to do, why you want to do it, and what makes you confident you can at least do it for a week"
Open ended questions	●	Strong on this.
Structure adapted to readiness to change, interest or self-efficacy	○	Not possible without branching in the interview script.
Other MI adherent behaviours (e.g., affirmations)	◔	Generally, not possible. "Looks like a plan", is an example but generally affirmation is risky if used without knowing what participant has said. Amplification of emotion is achieved through questions such as, "how does that make you feel?"

reflection to gain emotional depth. Here we used open questions to do this, for example, 'Why is that important to you now?' and 'How does that make you feel?'. Self-efficacy was promoted by asking about past successes and exploring how they could be applied to the current situation, eliciting awareness of increased confidence using 0–100 self-report ratings.

Questions throughout the interview were open-ended ('How does it make you feel?') and used collaborative language (e.g., 'So, is it okay if we talk about that now?'). The session ended with the video-counsellor asking the participant to 'summarise what you are going to do, why you want to do it, and what makes you confident you can at least do it for a week'.

To help readers compare this intervention against other TAMIs, Table 1 shows our characterisation of the script using Shingleton and Palfai's schema (Shingleton and Palfai, 2016). Shingleton and Palfai recorded the presence or absence of different features of MI. In Table 1, we have also indicated the quality of the features, as features may be present yet poor simulations of human MI. Note that the standard instrument for assessing MI quality, the Motivational Interviewing Treatment Integrity scale or MITI (Moyers et al., 2014), is not applicable here because it rates the interviewer's behaviour in relation to that of the interviewee. The full script is provided in Multimedia Appendix A to allow readers to arrive at their own judgement of quality.

2.2. Video-counsellor technology

The MI script was presented by an actor chosen by participants in pilot work from five potential video-counsellors. The selected actor was female, aged 30 years and of Eastern European background. She delivered the script using a teleprompter, in fluent but slightly accented English. A clip of the recording is provided in the Supplementary Materials. She was asked to present a neutral facial expression with a warm and empathetic tone. A 7-minute "listening video" was also shot with the actor looking directly at the camera, smiling slightly and nodding occasionally to simulate that she was paying attention to the participant's answers.

Recording took place in a video studio with a green chromakey. In post-production, the green background was substituted by a neutral grey backdrop and an artificial orange-tinted light was added for a warmer atmosphere (Fig. 1).

The recording was segmented and presented via computer as a Skype-style interaction where the participant viewed themselves in the computer's webcam as well as the video-counsellor (Fig. 2). Each question was followed by the 'listening video', which played in a loop until the participant pressed a key to move on. A short introductory clip from the video is shown in Multimedia Appendix B.

2.3. Evaluative questionnaire

An online questionnaire contained 24 open-ended questions covering the interaction with the video coach (e.g., How was your experience during the video interview?; How connected did you feel with the video coach?), self-perception during the interview (e.g., How did you feel about watching yourself answering the questions?; How important do you think it was listening to yourself out loud discussing your behaviour?), navigability (e.g., How did you find the interface?), motivation for change (e.g., Did this video interview affect your motivation?), engagement in physical activity after the program, and suggestions and criticisms about the program (e.g., What's the best (worst) aspect of this interview for you?). Questions also covered general aspects of motivation to elicit ideas that could be incorporated into future developments.

2.4. Participants

A total of 18 participants (6 male, 12 female; > 18 years) were recruited from the School of Psychology's pool of volunteers from the university and general public with a request for participants wishing to increase their physical activity levels. Participants received an honorarium of £8 per hour for taking part.

Fig. 1. Frames taken from one of the sample videos. A: raw video with chromakey and original light. B: video with the original light and replaced grey background. C: video with replaced grey background and light adjustment.

2.5. Procedure

The study was approved by the university's Faculty of Health and Human Sciences ethics committee. Participants visited the laboratory twice during July 2015: once for the video interview and again one week later to evaluate the intervention having had time to reflect upon its impact. In session I, participants were told that they would be interacting with a pre-recorded interviewer and automated system. They were asked to click on the button to advance to the next question when they were ready. They answered the video-counsellor's questions aloud in a simulated virtual conversation (Fig. 3). Their responses were video and audio-recorded. In session II, they completed the evaluation questionnaire online.

2.6. Analysis

2.6.1. Analysis of participants' speech for change and sustain talk

Participants' responses to the video-counsellor's question prompts were rated for the total number of replies that included any change talk (arguments towards the target behaviour) or sustain talk (arguments against the behaviour or for the status quo), both, or neither (Miller and Rollnick, 2012). Coding was performed by two independent raters not involved in the study. They rated all responses to question 1, in randomised order, followed by all responses to question 2, and so on. Disagreements were resolved by the first author, who additionally

classified the replies using the Client Behaviour Codes section (p.37 onwards) of the Motivational Interviewing Skill Code (MISC 2.5) (Houck et al., 2010)

2.6.2. Analysis of qualitative responses

Thematic analysis was used to identify and code patterns, or themes, in participants' evaluations of the video interview. We used the three-step method recommended by Boyatzis (1998): (1) sampling and design, (2) developing themes and codes, and (3) validating and using the codes.

(1) Sampling: There were 18 potential units of analysis, one set from each participant.
(2) Coding scheme: Themes and sub-themes were developed with a hierarchical relationship. The codes were developed according to Boyatzis' (1998) steps of immersive reading of the units of analysis, developing initial themes, then reviewing and revising the themes and sub-themes iteratively.
(3) The resulting code was validated by two independent coders who each applied the coding scheme to the responses of two randomly-selected participants, rating each theme or sub-theme as 'mentioned' or 'not mentioned' by the participant.

3. Results

Quantitative data and evaluation questionnaire responses are available on Zenodo: https://doi.org/10.5281/zenodo.3886459.

Analyses of interview length and change and sustain talk are based on responses from 16 of 18 participants (4 male, 12 female). Data from two participants (one gender neutral, one male) were excluded because they did not focus on a goal of increasing physical activity: one talked about quitting smoking and the other gave flippant answers about an apparent goal to smile more. All 18 evaluations of the interview were included in the thematic analysis.

3.1. Change and sustain talk

The interview lasted a mean of 10 min 30s (SD 3 min 0 s). The video-counsellor spoke for 4 min 16 s of this time, and participants for a mean of 6 min 14 s. Raters agreed on 92% of the statements. There was considerably more change talk than sustain talk (Fig. 4), with a mean of 16 replies out of 25 containing change talk (SD = 3.35, range 11 to 21) compared with a mean of 3.4 replies containing sustain talk (SD = 2.5, range 0 to 8). There were only 25 responses in total that contained both change and sustain talk. All participants engaged in more change talk than sustain talk, with the mean ratio being 7:1 (range 1.4:1 to 19:1). There were examples from all categories of change talk (Table 2).

3.2. Qualitative video-counsellor evaluation

Table 3 shows the list of all the themes and their hierarchical relationship.

3.2.1. Validating the code

The interrrater agreements for the two units (P8 and P17) were 90.41% and 80.82% respectively. Raters discussed divergences, and sub-themes were adapted accordingly.

3.2.2. Participants' evaluation
3.2.2.1. Program evaluation (1.1)

3.2.2.1.1. Coach (1.1.1). Some participants felt empathy towards the coach while others found the lack of individualised response frustrating. They felt that the coach could have been more responsive while listening to them.

I felt moderately connected [with the video coach], far more than filling

Fig. 2. Design for virtual interview. The video counsellor asks a question while the participant is seen live on the webcam. The participant clicks on the arrow button to advance to the next question.

out a survey but not as much as if the person had been an actual person rather than a virtual person.

(P4, age range: 34–42)

I felt like the interviewer was talking to me personally even though I knew it was a recording.

(P10, age range: 18–25)

Make the coach more interactive, especially whilst listening, responses to show that she is listening could be added, especially vocal ones.

(P8, age range: 26–33)

3.2.2.1.2. Interaction (1.1.2). The pre-recorded questions made the interview less fluid than one would expect in a face-to-face interaction. Most of the participants noticed that the questions were impersonal but could overcome this barrier and experience something that felt like a conversation.

It was engaging, not as much as if the person had been real and been relational but it was useful and relatively engaging once I got over how surreal it felt for the first couple of questions.

(P4, age range: 34–42)

One participant reported a particularly frustrating experience because:

I kept saying that the following 7 days was hectic & there was nothing i could do to alter that

(P5, age range: 43–60)

One of the two participants without a physical activity goal explained that they gave 'silly answers' because they felt embarrassed and awkward:

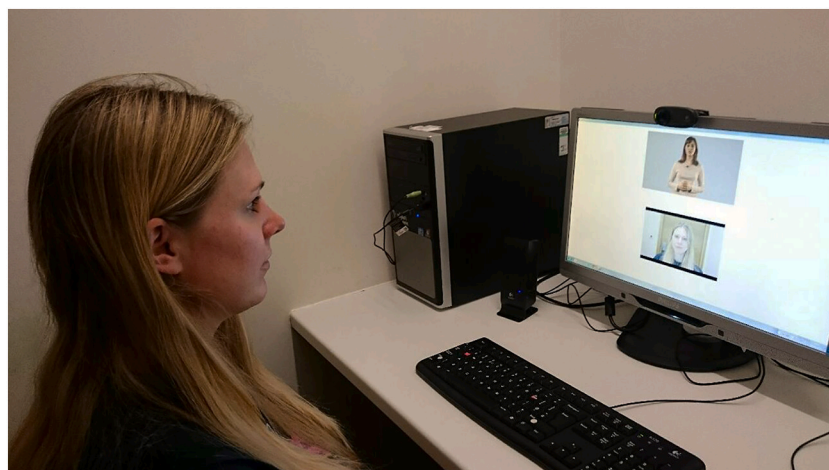*anxiety about doing an interview with a computer led me to not take it as*

Fig. 3. Simulation of the interaction between a participant and the video coach in the lab.
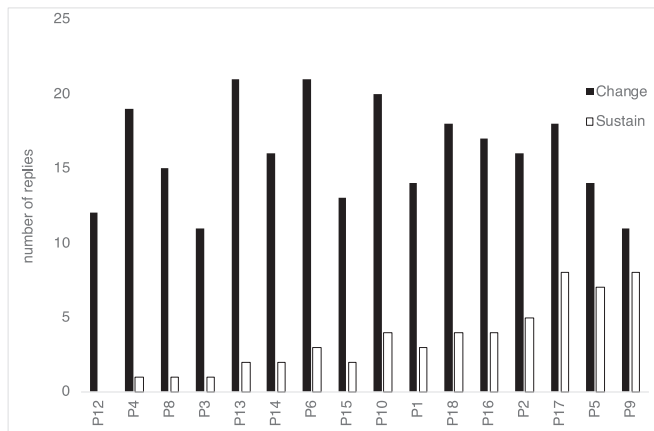
Fig. 4. Change talk and sustain talk during dialogue with video-counsellor for each participant, ordered by ratio of change:sustain.

seriously as I should. The idea that nobody was there to interact with my responses made me feel disconcerted….[I] felt like an idiot

(P7, age range: 34–42)

3.2.2.1.3. Script (1.1.3). There were mixed reactions to the necessarily generic questions.

The questions were clear and understandable. I did feel like I was repeating myself sometimes but I probably should have elaborated a bit more at those times.

(P10, age range: 18–25)

… not always clear, it was vague, and some more details would've been nice.

(P14, age range: 43–60)

3.2.2.1.4. Interface (1.1.4). Participants found the interface straightforward.

… very easy to use.

(P10, age range: 18–25)

3.2.2.2. Personal experience (1.2). The personal experience theme covered participants' experiences of using the virtual intervention, their strategies for motivating themselves, and their reflections on their behaviour in the week after the intervention.

3.2.2.2.1. Self-image on the webcam (1.2.1). We anticipated that participants would find the webcam interface familiar and comfortable, but most had a negative reaction:

[Watching myself on the webcam] took focus away from dialogue and interaction, [I] found myself looking at my body language.

Table 3
Coding scheme developed through thematic analysis.

Label	Themes and sub-themes
1	Video coach intervention
1.1	Program evaluation
1.1.1	Coach
1.1.1.1	Positive
1.1.1.2	Negative
1.1.2	Interaction
1.1.2.1	Emotional reaction
1.1.2.1.1	Positive
1.1.2.1.2	Neutral
1.1.2.1.3	Negative
1.1.2.2	Virtual system
1.1.2.2.1	Realistic
1.1.2.2.2	Not realistic
1.1.2.2.3	Restricted
1.1.3	Script
1.1.3.1	Positive
1.1.3.2	Negative
1.1.4	Interface
1.1.4.1	Instructions
1.1.4.2	Navigation
1.2	Personal experience
1.2.1	Self-image on the webcam
1.2.1.1	Positive
1.2.1.2	Neutral
1.2.1.3	Negative
1.2.2	Listening to oneself
1.2.2.1	Positive
1.2.2.2	Neutral
1.2.2.3	Negative
1.2.3	Motivation
1.2.3.1	Secondary strategies
1.2.3.2	Challenges
1.2.4	Engagement in physical activity after the program
1.2.4.1	Didn't increase exercise
1.2.4.2	Planned and executed activities, increased exercise, and/or intensity
1.2.4.3	Increased activity, but didn't meet goal
1.2.5	Overall evaluation
1.2.5.1	Suggestions
1.2.5.2	Positive appraisal

(P2, age range: 61–100)

I felt quite uncomfortable and it was hard to look at the camera, I felt that I had to look down most of the time. I felt like I was having the pressure put on me.

(P9, age range: 43–60)

3.2.2.2.2. Listening to oneself (1.2.2). Participants were positive about hearing themselves express their thoughts aloud, feeling that it helped the process of thinking about their behaviour and setting goals for the future. They gave a sense that speaking aloud made the issues

Table 2
Examples of change and sustain talk elicited by the video-counsellor.

Category	Change talk	Sustain talk
Commit	I've decided to do it and I'm going to do it.	Over the next seven days I'm fully occupied with various things and nothing will
	I'll start running again in the mornings, at least once or twice this week.	start in the next seven days.
Desire	I'd like to start doing [it] again.	I'm usually quite tired after work, and not really wanting to do anything.
	I want to improve my body postures.	Well, I've got some sports on the television coming up which is time consuming sitting watching that, and I wouldn't want to miss it.
Ability	I think I'm confident I'm able to start this mainly as it's something I really want to do. I know that I've succeeded in the past, so I can do it again.	Well, not sure if I can actually do it, maybe I need more support with that.
		I have very little confidence that I can get started because I'm so busy all the time.
Reason	I'd like to be as fit as possible now so that later on in life I have a better chance of good health.	
Need	I need to do more exercise to feel healthier.	I don't think it's too much of a worry because of what I already do.
Taking steps	I've been looking at fitness programs I can get into.	I seem to be spending a lot of time sitting when I should be out in fresh air.
	I've actually just been on holiday again and I've done two days of hard walking.	
Other	Running first thing in the morning helps motivate me.	It's about commitment and regularity and, having changed lifestyles and retired, that commitment and regularity isn't there.

feel more real: more urgent but also more achievable.

[Listening to myself out loud] was very important. It helped me to better realise my shortcomings and to come up with new potential solutions.

(P18, age range: 34–42)

[It] made me own the reality of my exercise habits which is otherwise easy for me to avoid.

(P4, age range: 34–42)

3.2.2.2.3. Motivation (1.2.3). Participants used a wide range of strategies to motivate themselves. Some strategies could be incorporated into a virtual intervention, for example reporting back on progress to the video-counsellor, but participants did not spontaneously make links between the video interview and their personal strategies.

[I tried other motivation techniques before]: affirmations and motivation meditation.

(P8, age range: 26–33)

[What helps me the most in staying motivated is] having to report back on my progress at a later date.

(P16, age range: 61–100)

… enjoying the activity and having some flexibility when I can do it.

(P1, age range: 26–33)

Participants mentioned a range of challenges that prevented them from achieving their goals. None spontaneously commented on whether the interview had helped them overcome these challenges.

… laziness - always having something else I'd rather do, even though I know I will feel happy once I've done the exercise.

(P13, age range: 26–33)

3.2.2.2.4. Engagement in physical activity after the program (1.2.4). Most of the participants engaged in physical activities in the week after the interview. The intervention prompted a quick planning reaction from some participants who immediately booked gym classes.

I booked all my gym classes in a week before …

(P4, age range: 34–42)

I started daily exercises, but not swimming like I thought about.

(P15, 43–60)

3.2.2.2.5. Overall evaluation (1.2.5). Participants suggested several improvements to the program.

… removing the video component and having an option to seek clarification or replay a question.

(P4, age range: 34–42)

… if she sat down and spoke it bit slower.

(P10, age range: 18–25)

…providing a way of listening back to yourself to see if you have met your goals.

(P6, age range: 18–25)

Participants said they valued the program because it offered an opportunity to think about the issues and voice their goals. They found it thought provoking. It helped them to make plans and strengthened their sense of responsibility for their own behaviour.

[The best aspect of this video interview was] the fact that I could voice my goals, and see the person voicing their goals – me – and realise that it was a person saying these things not just mere words.

(P14, age range: 43–60)

… reinforcing the pleasure I get from exercise.

(P2, age range: 61–100)

… it made me focus and to clearly articulate the problems, the

motivations, and the potential ways to overcome these.

(P18, age range: 34–42)

4. Discussion and conclusion

4.1. Discussion

We tested a virtual motivational interview that engages participants in a 'dialogue' where they speak aloud to a pre-recorded interviewer. Unlike other technology-delivered adaptations of motivational interviewing (TAMIs) that use video to introduce text-based interventions, our intervention required a spoken response from the participant and appeared to 'listen' to their answer. Participants found the interface easy to use but disliked seeing their own image in the live webcam projection. Although they would have liked a more personalised, tailored interaction, they still felt moderately engaged in the interview. They found listening to themselves verbalizing their goals and motivations for change to be important and effective, as predicted by self-perception theory (Bem, 1972). This is the most novel aspect of the intervention and the one that elicited the most positive evaluations. However, to determine whether it is speaking aloud that really underpins these evaluations, future research should compare this intervention with a version where participants type their responses.

Quantitative ratings of participants' speech showed seven times more 'change talk' than 'sustain talk'. In this respect, the TAMI achieved a key aim of a motivational interview, which is to elicit change talk. It did this through MI-consistent behaviours such as asking open questions and eliciting summaries (Table 1). Studies of the mechanisms of MI show more change talk when therapists use more of these MI-consistent skills (Magill et al., 2014; Apodaca et al., 2016; Moyers et al., 2007; Romano and Peters, 2016). Change talk is generally positively associated with outcomes (Apodaca et al., 2016; Moyers et al., 2007; Romano and Peters, 2016, but not Magill et al., 2014). These studies also found that MI-inconsistent behaviours, for example, giving unsolicited advice, were associated with more sustain talk and poorer outcomes. In this respect, our video-counsellor had an advantage over a live human interaction: there was no scope for those MI-inconsistent behaviours that are associated with poorer outcomes. However, there were many ways in which the intervention fell short of a motivational interview delivered by a human counsellor.

The relative simplicity of the video-counsellor interview may have weakened its impact. In designing the interview, we deliberately focused on eliciting talk about the benefits of change. Research with human interviewers shows that complexity is important. In our intervention, only one question specifically encouraged 'sustain' talk, where participants were asked 'Think about how you'll carry out your plan over the next week. Chances are it will be a bit harder at some times than others. Is there a time in the next few days that may be a bit harder? Tell me about that'. Lack of opportunity to reflect on the difficulties of change, and to hear those difficulties acknowledged, may be off-putting for participants who are more ambivalent about change. It may also reduce the effectiveness of the intervention. There is some evidence to suggest that the most effective MI is one that encourages deep, emotionally charged, exploration of discrepancy. Magill et al. (Magill et al., 2014) found some evidence that complex talk about change, where participants discuss positive and negative aspects together, might be the critical predictor of outcome. Similarly, Apodaca and Longabaugh (2009) found a positive association between outcomes and clients' experience of discrepancy. Few responses in the current study combined change and sustain talk. However, encouraging sustain talk as well as change talk in an automated interaction is potentially risky; it may reinforce the status quo rather than motivate change. Our interview provided an opportunity for participants to talk about the benefits of change. A recent study has shown that even when such change talk was coerced, because participants could only select textual

responses that were positive about change, there was an increase in confidence about change relative to a condition with 'sustain' response options (Olafsson et al., 2019), We assume that a live interaction, which used reflection to magnify participants' incentives and conflicts, would have strengthened motivation further.

Automating reflective listening remains a challenge for technology. Participants wanted the video-counsellor to be more responsive to them but, as (Kanaoka and Mutlu, 2015) found, getting the responses wrong can destroy the experience of an engaging 'conversation' that most reported. Spoken reflections need to amplify emotion and draw out underlying meaning rather than simply repeat or paraphrase. However, with rapidly improving natural language recognition, we assume this will become a possibility. Perhaps an equally difficult challenge is to automate reflective listening in the sense of aptly timed and appropriate vocal and facial gestures such as nods and smiles. We used a dynamic video of the actor 'listening' but kept gestures subtle because an ill-timed smile when a participant is talking about the difficulties they face could damage the perception of empathy. An interaction, human or machine-led, that did reflective listening well would generally be much longer – motivational interviews are typically 30–60 min compared with 10 min in this study – and it is not known how well a user would tolerate such a long interaction with a computer. However, the evidence discussed above suggests that it is the complexity of the interaction rather than the length per se (Walters et al., 2009) that mediates the effect of MI.

Another limitation with a TAMI is that it cannot, yet, express empathy in relation to the individual's specific utterances. Relational qualities such as empathy have positive effects on the client's within-session collaboration and engagement (Moyers et al., 2005) and possibly on outcomes (Gaume et al., 2009). However, Romano and Peters (Romano and Peters, 2016) did not find a clear association between relational variables and change talk or behavioural outcomes. Future research should test whether a TAMI that encourages change talk, as ours did, has a positive impact on behavioural outcomes even though it lacks some of the positive relational qualities of a live person-to-person interview. The question is not whether a TAMI is as effective as a conventional MI, but whether it can provide some benefit for people who do not have access to a therapist. A very recent study suggests that it might. In a stepped wedge design, Robinson and colleagues (Robinson et al., 2020) used a social robot to deliver an intervention called functional imagery training that combines MI with mental imagery exercises. A spoken interaction with this robot helped participants reduce their snacking and lose weight.

Participants suggested changes that could be incorporated into future TAMIs, including providing the opportunity to replay the video-counsellor's questions and to record and replay their own speech to check progress against goals. They wanted the interaction to be more personalised. There is a tension between developing virtual interventions that feel personalised, because they follow a logic tree specific to a particular context, and developing a general-purpose intervention that follows the same structure for all users. Our TAMI was developed for this second purpose, allowing participants to talk about whatever aspect of their goal they chose, and in that respect was true to the spirit of MI. However, a branching logic would allow the interview to be tailored to the individual's personal health status and theoretically-important variables such as readiness to change and self-efficacy. This form of tailoring increases the impact of print messages (Noar et al., 2007). Although Noar et al. (2007) found no moderating effect of personal characteristics such as age, gender or racial background, these factors may be important in a spoken intervention. In a 'dialogue' with a robot, participants commented positively that the robot was non-judgemental (Galvao Gomes da Silva et al., 2018). With a human interviewer, the match between the interviewer's and participant's personal characteristics might influence the extent to which the participant perceives the interviewer as non-judgemental. Anecdotally, we were interested that participants in our preliminary work selected as video-

counsellor the only actor who was a non-native English speaker, whose accent lacked the clues to class and status that participants might interpret as judgemental when listening to a speaker of their native language. Future research should establish if providing a choice of video-counsellor moderates any benefits of the interaction.

There is a similar tension between keeping the content of the intervention generic, so that it works as well for the person who wishes to quit smoking as for the one who wants to exercise more, and making it specific so that it clearly focuses on the user's specific goal. For the purposes of collecting coherent data for this study, we advertised for participants who wanted to increase their physical activity. We excluded two participants from the change talk analysis because they did not discuss physical activity goals, despite the study information sheet reiterating this focus. Future research should test the intervention in an unselected sample with heterogenous goals.

An important limitation is that the study participants were volunteers who were interested in health improvement. This is a very different population from a group of patients who are being asked to change longstanding behaviour patterns to reduce symptoms or prevent further deterioration of health. Future research needs to test how receptive a clinical population experiencing much greater ambivalence might be to engaging with an interview like this one that focuses primarily on the benefits of change.

Even with a population who are receptive to change, fully powered trials are needed to test if engaging with the virtual counsellor leads to more behaviour change than, say, text-based delivery of the intervention that omits the need for speaking aloud. Such research would more convincingly test the suggestion from this study that spoken 'dialogue' is an important contributor to the motivating effect of the TAMI. Research should establish if behaviour change elicited by a TAMI that encourages spoken interaction is mediated by change talk. It would also be interesting to establish whether people seeking motivational support will engage spontaneously and repeatedly with the intervention in real-world settings. If these conditions are met, then our study is a step towards delivering an automated motivational interview that is cheap, effective and widely accessible.

An automated motivational interview could be helpful as a stand-alone intervention but also as a component of broader eHealth interventions. Previous eHealth programs have been criticised for lacking human therapist involvement, leading participants to feel disengaged (e.g., Darvell et al., 2015). An automated video-counsellor could provide some sense of human contact and engagement, motivating users to begin or complete an online intervention, or helping people prepare for face-to-face counselling.

Without sophisticated speech recognition software or a live counsellor, it is hard to adhere to elements of MI such as reflection, but our interaction did include many important elements of MI including eliciting the participants' own values, goals and reasons for change. Participants felt they benefited from talking about change, even to a virtual interviewer asking generic questions, reinforcing the core tenet of MI that it is what the client says that is important, not what the interviewer says to evoke it. This study therefore represents a step towards developing an automated system that better invokes this important element of MI delivered by a human. By analysing the quality of participants' speech, we have also provided a baseline against which researchers can compare speech elicited by software that can emulate reflection, and a method for doing so.

4.2. Conclusion

A motivational interview with a pre-recorded video-counsellor elicited change talk and was perceived as motivating. Although the interactions described here fell far short of a face-to-face motivational interview, they show that a brief, generic and automated motivational interview can help people talk positively about their goals.

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