REGULAR ARTICLE

How is the Behavior Change Technique Content of the NHS Diabetes Prevention Program Understood by Participants? A Qualitative Study of Fidelity, With a Focus on Receipt

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Abstract

Background The National Health Service (NHS) Diabetes Prevention Program (DPP) is a nationally implemented behavioral intervention for adults at high risk of developing Type 2 diabetes in England, based on a program specification that stipulates inclusion of 19 specific behavior change techniques (BCTs). Previous work has identified drift in fidelity from these NHS England specifications through providers' program manuals, training, and delivery, especially in relation to BCTs targeting self-regulatory processes.

Purpose This qualitative study investigates intervention receipt, i.e., how the self-regulatory BCT content of the NHS-DPP is understood by participants.

Methods Twenty participants from eight NHS-DPP locations were interviewed; topics included participants' understanding of self-monitoring of behavior, goal setting, feedback, problem solving, and action planning. Transcripts were analyzed thematically using the framework method.

Results There was a wide variation in understanding among participants for some BCTs, as well as between BCTs. Participants described their understanding of "self-monitoring of behaviors" with ease and valued BCTs focused on outcomes (weight loss). Some participants learned how to set appropriate behavioral goals. Participants struggled to recall "action planning" or "problem solving" or found these techniques challenging to understand, unless additional support was provided (e.g., through group discussion).

Conclusions Participants' lack of understanding of some self-regulatory BCTs is consistent with the drift across fidelity domains previously identified from NHS design specifications. Behavioral interventions should build-in necessary support for participants to help them understand some BCTs such as action planning and problem solving. Alternatively, these self-regulatory BCTs may be intrinsically difficult to use for this population.

Keywords Behavior change technique · Diabetes · Fidelity · Intervention · Prevention · Receipt

Background

The number of people living with diabetes worldwide is projected to increase by 25% in 2030 and 51% in 2045 [1]. As type 2 diabetes (T2DM) is largely preventable, diabetes prevention programs have been implemented around the world with the aim of improving dietary and physical activity behaviors. These programs show great promise in terms of preventing progression to T2DM and reductions in body weight and blood glucose [2].

In 2016, National Health Service (NHS) England launched the Healthier You: NHS Diabetes Prevention Program (NHS-DPP). The NHS-DPP is a 9-month behavioral intervention for adults in England at risk of developing T2DM [aged over 18 years and with nondiabetic hyperglycemia (NDH)]. The program was implemented across England in three waves between 2016 and 2019 [3], and delivered by four independent providers commissioned to deliver the program, based on NHS England specifications. Three of the providers were national organizations who deliver a range of programs for health, wellbeing and employment, and one of the

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providers was a non-profit organization. The NHS-DPP has now been rolled out nationally and, since 2019, is delivered by five providers. Early outcomes from the NHS-DPP are favorable in terms of weight loss and NDH (as measured by HbA1c) in those that complete the program [4, 5].

The NHS service specification for the NHS-DPP is a framework describing the intervention features which should be present within the NHS-DPP [6]. The program constitutes a minimum of 13 face-face group sessions over 9 months and the content primarily targets dietary and physical activity behaviors, with weight loss a desired outcome for participants who are overweight or obese. Specifications for the format and content of the NHS-DPP have been based on evidence outlined in a systematic review [2] and a National Institute of Health and Care Excellence (NICE) public health guideline [7].

A key component of the NHS service specification is that it specifies 19 behavior change techniques (BCTs) that should be delivered within the NHS-DPP [8]. BCTs have been defined as observable, irreducible, and replicable components of an intervention, often referred to as the "active ingredients" designed to change behavior (e.g., goal setting, feedback, and reinforcement) [9]. A number of the BCTs specified for inclusion in the NHS-DPP address self-regulatory processes, that is, those in a feedback loop consistency of goal setting, recognizing inconsistencies between goals and current behavior, and developing plans to mitigate those inconsistencies [10] [also see logic model [11]]. Their presence in the NHS Service Specification is a result of existing evidence that suggests that these self-regulatory BCTs are an important component of behavioral interventions relevant to T2DM prevention [6, 7].

To fully understand whether interventions are effective, we need to understand whether these interventions are designed, delivered, and received as planned (fidelity). One popular framework for understanding fidelity is that of the National Institutes of Health Behavior Change Consortium (NIH-BCC), which has conceptualized fidelity across five domains [12]. The five domains of this framework each reflect a stage of an intervention: study design (whether the planned intervention is in line with underlying theory), training (whether deliverers are trained in key components of the planned intervention), delivery (whether the intervention's key components are actually delivered), receipt (whether recipients understand the intervention), and enactment (whether recipients incorporate the key components of the intervention in their day-to-day lives) [12].

Without an assessment of fidelity, reports of an effective intervention could be a function of either an effective intervention or the influence of other unknown factors added to or omitted from the intervention [13]. Findings from fidelity assessments can often inform implementation of programs in practice and identify solutions for more effective roll-out of programs. Despite the importance of understanding fidelity, there has been a lack of attention in the field [14], wide variability in approaches to measuring fidelity [14, 15], and a call for high quality measures of fidelity to be developed [16].

Our research team has previously reported on fidelity from the evidence base to the design, delivery, and training components of the NHS-DPP [8, 17, 18]. Although overall fidelity was good, a drift in fidelity was evident in terms of the BCTs targeting self-regulatory processes, such as setting goals, self-monitoring behavior, and making plans [10]. The training of facilitators in these self-regulatory BCTs was variable across providers; training of BCTs that are designed to improve self-regulation of behavior often involved simple instruction without further demonstration or practicing of the technique [18]. The present study focuses on receipt fidelity: an assessment of how participants understand the intervention and are able to perform the behavioral skills or cognitive strategies delivered to them during the intervention.

This study concentrates on self-regulatory BCTs; this is driven by the evidence-base [6, 7] highlighting the key role of self-regulatory BCTs in changing health behaviors. The present study was designed before results of the training and delivery analyses were available, but, nonetheless, this evaluation of receipt has the additional benefit of understanding the implications of our previous findings (regarding upstream domains of fidelity) on participants' understanding of the BCT content of the program. It is helpful to know whether the drift in fidelity and sub-optimal training of deliverers of the NHS-DPP might have impacted on how participants understood the BCT content of the program. Importantly, even if the program was designed and delivered with high fidelity, the NHS-DPP might still not be as effective as it could be if people do not fully understand BCTs as the active ingredients within the program.

Within the literature on fidelity of complex behavior change interventions, fidelity of receipt has been less well studied than other components of fidelity. A systematic review [19] reported that only 19.6% of 33 fidelity studies addressed receipt, and most of these were based on quantitative methods such as self-report questionnaires or attendance logs. This is a concern because participants need to be able to understand the key components of an intervention delivered to them. They are not simply passive recipients of the intervention but need to develop behavioral skills and cognitive strategies so they can fully enact the key components of the intervention in their

day-to-day lives in order to change their behaviors and thus prevent ill health [20].

It is important to assess how participants understand the BCT content of the NHS-DPP, specifically in terms of how they make sense of the behavior change content of the program, the skills and strategies they have acquired, and how they might use these in their day-to-day lives, rather than a simple assessment restricted to what new knowledge participants have acquired. In line with recent calls for more qualitative work on receipt and enactment [20], the research team decided to assess fidelity of receipt qualitatively, in order to gain a broader insight and in-depth understanding of participants' comprehension of the BCT content of the program. Using qualitative methods to investigate receipt allows exploration of *how* participants understand key components of an intervention, including their description of skills they have learned (cognitive and behavioral) and their confidence in implementing them. The NHS-DPP affords a rare opportunity to independently evaluate fidelity of receipt in the national roll-out of a major public health intervention. The primary aim of the present study was to evaluate how participants in the NHS-DPP understood the BCT content of the program.

Methods

Participants and Setting

Participants were identified from a list of NHS-DPP participants ($n = 101$) who had provided consent to be contacted during a previous study involving observation of the program at eight sites between August 2018 and November 2019 [17]. There were two sites for each of the four providers' NHS-DPP programs across eight locations in England. Participants were purposively sampled using available details on site and approximate completion (from the list of consented participants) and demographic questionnaires (completed at time of interview, see below). The aim was to secure a broad representation of participants from across the eight sites in relation to percentage completion of program sessions, age, gender, and ethnicity.

Design and Procedure

Participants were interviewed once between January and May 2020, after they had completed their programs. Participants were recruited by telephone and sent a participant information sheet to review before giving consent (in an audio recording) to take part in the study. All interviews were conducted by telephone by one researcher (LMM) and lasted 30–60 minutes. Each interview was recorded and transcribed verbatim for analysis.

Topic Guide

The topic guide (see Supplementary Material 1) for the interviews focused on participants' general experiences and engagement with the NHS-DPP as well as their understanding of a range of self-regulatory BCTs (those where evidence supports their inclusion in a behavioral intervention) (BCT v1 taxonomy reference in brackets): action planning (1.4), goal setting for outcome (1.3), goal setting for behavior (1.1), feedback on behavior (2.2), feedback on outcomes of behavior (2.7), self-monitoring of behavior (2.3), and problem solving (1.2). The topic guide focused on understanding of BCT (receipt domain) and was adapted from one used in a previous study focusing on fidelity receipt [21]; it was adapted to concentrate on self-regulatory BCTs. The topic guide was used flexibly in interviews to allow discussion of enactment of BCTs when participants spontaneously shared relevant experiences. Each participant was asked to complete a short demographic questionnaire at the end of the interview to facilitate description of the study participants.

Analysis

Data were analyzed thematically and organized using the framework method [22]; this method involved the development of a framework matrix that allowed comparison of findings across participants and providers where relevant. After initial familiarization with the transcripts, four transcripts were coded inductively by one researcher (LMM) and reviewed and discussed in detail with another researcher to agree upon subsequent approach to coding. A decision was made to continue to inductively code the remaining transcripts, closely referring to the pre-specified research question: how do participants describe their understanding of the BCT content of the program. Material in the interviews that did not address this research question (such as general comments about experiences of the program) will be analyzed in a separate study.

The coding framework was refined throughout by LMM. Before generation of the framework matrix, the analytical coding framework was further reviewed and refined by two researchers (LMM and REH). The data were then charted into a framework matrix which was discussed at length amongst three authors (LMM, REH, and DPF) to identify themes relevant to the research question, which focuses on receipt of BCTs.

Our analytical approach was to purposefully use the in depth participant descriptions afforded by qualitative methods, to describe *how* participants understand BCTs, rather than categorize their understanding as good or poor. Key features of understanding we considered included (but were not limited to): participants' recall of the technique within the program; their description of

knowledge of and performance of cognitive and behavioral skills; their confidence in implementing a technique; and their use of a technique as a strategy to change behavior. The latter encompasses enactment (defined as performance of behavioral skills and cognitive strategies in relevant real life settings [12]) but we felt this to be appropriate as receipt is a precondition for enactment, and we did not want to constrain the inductive nature of the analysis.

NVivo software (version 12) was used to facilitate coding and analysis of the data.

Results

The 20 interviewees comprised almost even numbers of males and females and had a median age of 66 years. Around a third of participants had completed all sessions of the NHS-DPP (see Table 1). See Supplementary Material 2 for a flow diagram detailing participant recruitment.

Analyses showed a wide variation in understanding (i.e., how a technique might work or be useful to facilitate behavior change) among participants of some BCTs; there was a particularly wide variation among participants in their understanding of the BCTs goal setting and problem solving. There was also a wide variation in understanding between BCTs, in that participants generally described a greater understanding of some BCTs more than others. On the whole, variation in understanding of BCTs could not be attributed to different providers, with one exception described further under themes. Five themes were identified in the analysis: (a) ease of understanding and enactment of self-monitoring of behaviors; (b) valuing focusing on outcomes; (c)

learning to set appropriate behavioral goals; (d) support required to understand how to apply techniques to facilitate behavior change; and (e) group discussion facilitates understanding of problem solving.

Ease of Understanding and Enactment of Self-monitoring of Behaviors

Across all provider programs, participants were consistently asked to track their diet and/or physical activity as part of the program. Step counters were often provided to participants as part of the program but participants felt they were too basic, did not work well, or were not given out at an appropriate time during the program. Nevertheless, participants commonly did self-monitor their physical activity, often using their own tracking device. The self-monitoring of physical activity in this way was often self-directed and it was not always clear whether the self-monitoring of physical activity would have taken place outside of the NHS-DPP regardless, or whether the self-monitoring content of the NHS-DPP helped us to emphasize the importance of the self-monitoring to support behavior change:

"I think it's all about - it's everything that's in the atmosphere almost, you know? People talk about how many steps they do, it's part of common language now that's talked about…." (Male, 54 years).

Of all the BCTs discussed in the interviews, participants talked most fluently about their understanding of "self-monitoring of behaviors". Participants described their understanding of self-monitoring with ease, and provided clear descriptions of enactment of this technique during and beyond the program. Participants

Table 1. Demographic characteristics of interview participants

Characteristic			Total ($N = 20$)
Age (years)	Median	66	19
	Range	45–80	
Gender, n (%)	Female	10 (53)	19
	Male	9 (47)	
Ethnicity, n (%)	White British	14 (74)	19
	Other	5 (26)	
% Completion of program, n (%)	100%	6 (32)	19
	75%–99%	5 (26)	
	50%–74%	6 (32)	
	<50%	2 (11)	
Provider of program, n (%)	Provider A	5 (25)	20
	Provider B	5 (25)	
	Provider C	4 (20)	
	Provider D	6 (30)	

referred to how they used self-monitoring to support behavior change for their own context, with a common theme being using self-monitoring behaviors to support self-regulatory processes (monitoring progress towards goals, making immediate adjustments, reflecting on current behaviors, and identifying changes that are needed). Participants were using "self-monitoring of behaviors" to support reflecting and changing both physical activity and dietary behaviors:

"… certainly I do remember thinking, oh, I've not done my ten thousand today, I need to walk more tomorrow which I did, and I did make a point of that (female, 72 years, referring to tracking physical activity)";

"like I say, when it's in front of you and if you are honest with yourself, you do actually think, ooh, that's bad, and, ooh, that's bad, and that's bad. When you're thinking about it, you don't. You don't say that to yourselves (male, age 45 years, referring to reviewing a food diary)".

However, participants recalled receiving little feedback from facilitators on the dietary and physical activity behaviors they had been tracking. What little there was (for example, prompts to review their own records of diet or physical activity) was designed to stimulate self-reflection:

"I think there might have been a general sort of, have you used your step counter, have you checked your steps, sort of discussion in the group. But there was no individual follow up and it was all a bit vague (female, 67 years)".

Valuing Focusing on Outcomes

Participants were routinely weighed at each session and were informed of their bodyweight, which is in line with the BCT "feedback on outcomes of behavior" [9]. It was universally clear that monitoring of body weight was a key component of the program for participants. They very much valued being monitored and found the regular "weigh-in" motivating and made them feel accountable:

"well, it was good to get weighed every week in front of people. I found that, you know, at the time sort of encouraging (female, 68 years)".

However, many would have liked more opportunity for in depth discussion about the reasons for changes to their bodyweight. Participants did not see being briefly informed of their new bodyweight as "feedback." This is in contrast to the BCT definition, which includes simply informing a person about how much weight they have lost following a regimen, as an example of the BCT "feedback on outcomes of behavior" [9]. So in this situation, how participants' make sense of this BCT is different to that implied in the BCT taxonomy (v1). Several participants described being weighed as a very brief process:

"….it was literally just a question of, step on the scale, step off, thank you very much (male, 62 years)".

On the rarer occasions when participants did report receiving detailed feedback they valued this and enjoyed receiving praise.

Participants frequently described having a weight loss target as part of the program. When participants were asked about goal setting, several described setting a goal for weight loss (outcome goal), sometimes with reference to completing sections of the workbook:

"and the goal was always to lose weight before the next session [laughs], you know, and we'd got a month to do that. (female, 72 years)".

In some cases, it was difficult for the participant to describe how they used goal setting, in relation to specific behaviors, to reach their outcome goal:

"….part of the goal was that you actually lose weight, which I did and also to increase the physical exercise which I eventually did. What was the other goal? … Basically it was just be very wary of what you eat and when you eat so not to damage your health (Male, 67 years)".

Learning to Set Appropriate Behavioral Goals

The majority of participants recalled goal setting being introduced in the sessions. For some, their experience was that it was dealt with in a limited way, with a focus only on outcomes such as weight loss and/or non-specific behaviors. Many others were able to clearly describe how they had gradually learned the principles of setting appropriate goals for specific behaviors (for example, snacking behavior and sedentary behavior at work) while taking part in the NHS-DPP. Several participants referred to learning about SMART goals (e.g., making them specific, measurable, attainable, relevant, and time-bound) and found this technique motivating and useful. In particular, participants described a journey of learning how to use goal setting effectively as they moved through the program, by gradually understanding the need for goals to be realistic, set by themselves, and to aim for specific behavioral goals "little by little":

"Goals are good providing you make them reasonable. I mean, it's rough trying to change two or three things at one go, just change one thing at a time. 'Cos that's what I found. Initially I said, I'll increase my activities and I'll reduce what I'm eating and stuff like that, but because I tried to do all of it together initially, you know, you struggle. So I think the best thing is to just do one thing and once that becomes a norm to you, then put another activity or other goal on top of it (Female, 58 years)".

Support Required to Understand How to Apply Techniques to Facilitate Behavior Change

Limited recall and understanding was evident amongst participants when they were asked about some self-regulatory BCTs that were included in the intervention design. Most participants recalled "action planning" in a limited fashion; they tended to recall the terminology or refer to a section in their program workbooks that they were asked to complete. Several participants referred to action planning as "homework," implying that it was delivered as a task to complete on their own in their own time:

"it was like homework and when people are in their sixties and seventies they're not really interested in homework are they, they just want answers. Quick-fix answers (female, age 56 years)".

This suggests that participants may have received little or no support from the facilitator to help them understand *how* to develop an appropriate action plan (e.g., specifying detailed planning of desired behaviors such as where, when, and how long), and that such support and discussion is needed to facilitate understanding:

"I think how it can help them is if somebody discusses it with them. And there's only one facilitator there and you've got about twenty participants in the room which is quite a lot of people because they can't fit them all in (female, 56 years)".

Consequently, although the term "action plan" was recognized, participants struggled to provide any deeper understanding of how they might "action plan" to support behavior change, even when prompted further to elaborate. There was some notable variation across providers. Participants from programs run by some providers (A, B, and C) showed very limited understanding of "action planning". The few participants (mostly from provider D) that were able to describe some understanding of action planning referred to the value of writing down a plan but the need for further action to carry out their plans. Even for Provider

D's participants, it was not clear that recipients of this BCT were able to make use of this technique to support behavior change.

Limited recall and misunderstanding was also evident in several participants when they were asked about "problem solving". Participants tended to respond to questions about "problem solving" in one of two ways: they either did not recall "problem solving" with reference to behaviors, or referred to a useful group discussion about barriers to behavior change and possible solutions (see theme 5). Consequently, some participants misunderstood the term "problem solving." They did not understand this to mean identifying barriers to desirable behaviors and finding solutions to these barriers, but instead talked about "problems" related to health consequences of T2DM or understood "problem solving" to mean an interactive activity completed as part of the program. These misunderstandings were evident despite several attempts by the interviewer to use prompts to explain the meaning of problem solving as a BCT.

Group Discussion Facilitates Understanding of Problem Solving

In contrast, some participants described helpful group discussions around "problem solving" to support behavior change. They found this a useful exercise to think about their own barriers and solutions to behavior change:

"yeah, so we were working in groups and we had to say what stops us doing exercise, and then the other group had the question, well, you know, how could you overcome barriers to exercise, something like that………and I think the result of that was there were actually no barriers to doing any exercise [laughs],… (female, 66 years)".

Participants described how group discussions were helpful: to hear from others about identification of problems and finding solutions:

"and when there's a few of you bouncing off, well I can't do that, well have you tried that instead? They were getting, within the group, they were getting there, the others was helping in that respect (female, 68 years)".

It was an example of how sharing stories among the groups facilitated peer support:

"you're not alone, that everybody's in the same boat, you know. Everybody thinks in similar things. We're not all super people. So that was like

a comfort, people saying, "Oh yeah, I'm the same" (female, 66 years)".

Taken together, this suggests that additional support is important to facilitate participant understanding of both "action planning" and "problem solving", either in the form of coaching from the facilitator or peer-peer support in a group discussion. This is likely because these BCTs can be viewed as more cognitively demanding; they require a person to think about not just what they want to change, but the steps they need to take to achieve change. Developing such cognitive strategies alone may be too challenging.

Discussion

Key Findings

Overall, this study showed a wide variation in understanding amongst participants for some self-regulatory BCTs. There was also variation between BCTs, in that some BCTs were generally understood more than others. The majority of participants could describe their understanding of "self-monitoring of behaviors" with ease; they reported enacting related skills in their real-life settings and used this technique to support self-regulatory processes. Participants very much valued having a target for weight loss and their bodyweight monitored in line with the BCTs "goal setting (outcomes)" and "feedback on outcomes." A subset of participants were able to explain how they learned within the program to set appropriate behavioral goals [goal setting (behavior)]. In general, participants tended to struggle to recall "action planning" or "problem solving" as part of the program or found these techniques more challenging to understand, unless additional support was provided (through a helpful group discussion in the case of problem solving). "Action planning" appears to have been often delivered as a task to do alone once the session was finished; this lack of support may have contributed to why most participants were unable to describe how this technique might be useful.

Strengths and Limitations

A strength of the present study is the use of qualitative methods to investigate receipt fidelity, which has been called for by previous researchers [20, 23]. Although intervention receipt fidelity has been recently evaluated qualitatively for some physical activity interventions [21, 24–26], to our knowledge the present study is the first time a qualitative approach has been taken in an evaluation of receipt fidelity of a large nationally implemented program. Taking a qualitative approach has allowed an in-depth understanding of participants' comprehension of the BCT content of the NHS-DPP. In addition, interviewees were recruited from eight delivery sites across diverse geographical regions of England and considerable efforts were made to purposively sample participants in terms of age, sex, and ethnicity, with a final sample broadly representative of participants in the NHS-DPP [27]. In addition, we were able to investigate receipt across a program delivered by four different providers working to a common evidence-base. A further strength is that this study has been conducted independently of those involved in the development of the NHS-DPP intervention.

Nevertheless, there are important limitations to consider in drawing conclusions from this work. Participants were interviewed after they had completed a NHS-DPP program which typically took 9 months and may have had some difficulty recalling the detail of the program. However, one might consider that the BCTs a participant found most useful would be easier to describe as they are designed to have a lasting impact on behavior change. In addition, it is possible that some BCT content could have been delivered in individual sessions that a participant did not attend and so they were not able to recall receiving a specific BCT. Further, 89% of the sample of participants had completed all or most of the sessions of the DPP; it is possible that NHS-DPP participants who had completed much less of the program might have reported differences in their understanding of the BCT content of the intervention.

Our approach in this research was to describe *how* participants understand BCTs, rather than categorize their understanding as good or poor. We acknowledge that the absence in the literature of a clear definition of what "good" receipt looks like for the range of BCTs covered has required us to take a pragmatic approach to identifying what might be considered problems in "understanding." When interpreting the findings beyond analysis, we have taken clear participants' misunderstanding of, e.g., the purpose or what a BCT requires, to mean understanding has been challenging and could be improved.

Relationship With Other Research

The present study addresses a scarcity in direct evidence on how BCTs are understood by recipients of a behavioral intervention, and how this might vary across different population groups. Our finding regarding participants requiring support to aid understanding of some BCTs, such as peer-support through group discussion about problem solving, builds on qualitative findings

from the NHS-DPP pilot [28]. This study found that service users described group support as an essential feature of the NHS-DPP sessions and that such support included peers sharing similar experiences and troubleshooting during the sessions. It was also felt that group sizes needed to be manageable in order for facilitators to provide personalized advice. Similarly, it was reported that shared experiences facilitated problem solving and bolstered self-efficacy in the Norfolk Diabetes Prevention Study [29]. Furthermore, our findings regarding participants' valuing having their bodyweight monitored are in line with findings from the same study, where weigh-ins within the group setting were found to give participants a sense of accountability.

Other qualitative studies of receipt have investigated fidelity to behavioral interventions across a range of settings, such as schools [25], general practice [21, 24] and the community [26]. The community-based study [26] explored men's experiences of using pedometers to increase physical activity in a group-based weight management program; interviewees portrayed the device as a facilitator that helped them to keep a track of and achieve their goals and this, in turn, helped them to internalize self-regulatory habits into daily life. This is consistent with our findings regarding the usefulness of "self-monitoring of behavior" for supporting self-regulatory processes.

It is also appropriate to consider our findings on fidelity of receipt within the broader context of our research team's previous findings on upstream domains of fidelity, which show a drift in fidelity from evidence base to design of the NHS-DPP [8], then also to training and delivery of the NHS-DPP [17, 18] (see Table 2). It is clearly conceivable that participants might not understand BCTs that were not delivered to them, or not delivered adequately. We previously concluded that self-regulatory BCTs were under-delivered in the NHS-DPP [17] and this

could account for why many participants were not able to describe a clear understanding of some BCTs in the present study. The findings on frequency of delivery of a range of self-regulatory BCTs in this study are broadly consistent with the qualitative findings presented here (see Table 2). The BCTs "self-monitoring of behavior" and "feedback on outcomes" were delivered frequently (participants described a clear understanding of these BCTs); there was wide variation in the frequency of delivery of "goal setting (behavior)" and "problem solving" across providers (there was wide variation in how participants understood these BCTs), and (with the exception of one site) "action planning" was delivered infrequently (participants struggled to describe their understanding of this BCT). The variation in frequency of each BCT delivery across providers could, to some extent, explain the variation in understanding of the BCTs reported in the present study. Of course, consideration only of frequency of BCT delivery is somewhat limited as BCTs can be delivered via different modes or with varying quality of delivery. Previously, an evaluation of goal setting in the NHS-DPP has reported that quality of goal setting delivery is not in line with what the evidence-base suggests is most effective [30] and our research team has previously concluded that more comprehensive training in BCTs for deliverers of the NHS-DPP BCTs is required [18]. The quality of delivery of BCTs in the NHS-DPP may warrant further research.

In the present study, the understanding of "self-monitoring of behaviors" was universally well understood despite some variation in frequency of this BCT delivery across providers. Further, the understanding of "action planning" was generally poorly understood even though one provider delivered this BCT with relatively high frequency [17]. It is possible, therefore, that some BCTs are intrinsically easier for participants to

Table 2. Frequency of behavior change techniques delivered across whole course in each of eight sites (4 providers) across England

Frequency of delivery of self-regulatory behavior change techniques across 4 providers, 2 sites per provider

	Provider A		Provider B		Provider C		Provider D	
	Site A1	Site A2	Site B1	Site B2	Site C1	Site C2	Site D1	Site D2
Mean number of participants per session (range)	12 (5–19)	14 (4–21)	17 (12–23)	16 (11–23)	14 (7–30)	10 (5–19)	9 (2–16)	7 (4–13)
Behavior change technique								
Self-monitoring of behavior	6	10	1	9	25	23	7	5
Feedback on outcome(s) of behavior	9	12	12	12	16	17	13	13
Goal setting (behavior)	1	1	5	11	14	8	7	5
Problem solving	12	7	4	5	18	13	9	6
Action planning	0	0	7	7	13	7	6	4

Extract from Table 2 in: French DP, Hawkes RE, Bower P, Cameron E. Is the NHS Diabetes Prevention Program Intervention Delivered as Planned? An Observational Study of Fidelity of Intervention Delivery. *Ann Behav Med* 2021.

understand, for example, "self-monitoring of behavior", perhaps due to prior familiarization of the concept before embarking on the NHS-DPP, whereas "action planning", for example, might be intrinsically more difficult a concept to grasp. Although existing research in this area is scarce, one study has suggested that effectiveness of an implementation intentions intervention (comprising "action planning" and "problem solving") is moderated by executive function [31].

This study has highlighted a difficulty in disentangling understanding of BCTs (receipt) from their enactment, which are described as separate domains in the NIH-BCC framework for fidelity [12]. Our original aims to focus on receipt have been broadened to encompass participants' descriptions of enactment as they arose. This is largely because participants naturally wanted to share what *action* they have taken in their day-to-day lives, rather than, for example, speaking of the concept of self-monitoring in an abstract way, and how it might help one self-regulate their activity levels. Our experiences allow us to suggest that participants are unlikely to describe their understanding (receipt) of BCTs without referring, at least to some extent, to their enactment of BCTs in a flexible qualitative interview. We therefore advise future qualitative work on understanding of BCTs to not be constrained to receipt only; encompassing enactment could usefully also be considered.

Further to this, it is also possible that participants find it easier to talk more naturally about BCTs that require self-enactment. So BCTs such as "self-monitoring of behavior" require the participant to conduct frequent repetition of enactment of the technique (i.e., repeated tracking exercises) and so may be easier to recall and describe how and why they are doing it. This would be different to, for example, a BCT that is enacted once such as "goal setting (outcomes)," or is received more passively, such as "information on health consequences." The concept of self-enactable BCTs has recently been discussed in the literature [20, 32] and may warrant further exploration in future research, particularly in relation to how participants understand self-enactable BCTs and are able to incorporate them into their day-to-day lives.

It is also possible that some demographic features of NHS-DPP participants, such as middle to older age or occupational status (retirees), mean they are less receptive to receiving self-regulatory BCTs as intended. A systematic review [33] concluded that many commonly used self-regulation intervention techniques that are effective for younger adults may not be effective for older adults, possibly because self-regulatory BCTs are either more cognitively difficult or less acceptable for older people. For example, differences in understanding and enactment of self-regulatory BCTs according to participant age have been reported in a feasibility study of a walking intervention [24]. Occupational status appeared to influence the

participants' understanding of the "action planning" technique in the same intervention, with employed participants seeing the value of "action planning" to help them incorporate walking into their working day, whereas retirees preferred using the flexibility of time afforded to them in retirement [22]. It is important that the BCT content within any intervention is appropriately targeted to, and understood by, the relevant population group.

Implications

Overall, this study raises concerns that participants in the NHS-DPP require further facilitator or peer-support to help them understand some self-regulatory BCT content of the program. This implies that there is a need to ensure that the BCT content of the program is delivered "better" or at least given a higher priority in terms of the delivery of the program, and that high-quality BCT training is in place for deliverers of the program. Further, in future iterations of the service specification for the NHS-DPP, commissioners need to put greater effort into ensuring provider organizations deliver self-regulatory BCTs with the necessary support for participants to understand them. In the context of our previous work on fidelity, the present study adds to the suggestion of sub-optimal delivery of BCTs within the NHS-DPP, as limited understanding of some BCT content has been identified. Such potential improvements to the NHS-DPP program, in terms of both service specifications and program delivery, could enhance effectiveness of the NHS-DPP program.

Following recent calls for more analyses of the potential association between fidelity assessments with health outcomes [15], it may be beneficial to compare findings from our work on all domains of fidelity with research on the effectiveness of the NHS-DPP on risk of T2DM (HbA1C) and weight loss. A previous study has analyzed health outcomes in a sample of completers of the NHS-DPP referred to the program prior to March 2018 [5]. Both HbA1c and weight decreased on average among those retained to at least 6 months across all providers, though there was a substantial variation in HbA1c change and a smaller variation in weight loss between providers. Examination of how variation in all domains of fidelity across providers is associated with variation in health outcomes across providers could signpost where improvements to the NHS-DPP could be achieved.

The findings of this study have further wider implications for the development and implementation of other behavioral interventions using self-regulatory techniques. It is encouraging that a widely used BCT, "self-monitoring of behaviors", is understood with ease, perhaps because it is a self-enactable BCT, prior familiarity with the technique, or simply because it is an intrinsically easier concept to understand. Interventions

that involve regular bodyweight monitoring are valued, though participants' experiences of this technique could be improved by providing more room for detailed feedback. A pertinent learning for the field is that participants require some support, for example, from peers or a facilitator, to help them understand "action planning" and "problem solving". It is crucial to build this into the development of future behavioral interventions; we cannot assume that passive receipt of a BCT means a person will understand it and be able to enact it in day-to-day life. Our findings on "goal setting for behaviors" show it is possible for some participants to learn how to set behavioral goals appropriately; though again support in doing so is likely to be an important feature of any intervention.

Findings from the present study suggest there could be some BCTs that are intrinsically easier to understand than others, at least in the population studied. The evidence-base for many behavioral interventions is based on highly controlled RCT conditions that are not emulated in roll-out of programs, including a more selected population. Given this, future research is warranted to further understand whether specific demographic characteristics of behavioral intervention recipients influence their understanding of BCTs. It is also possible that some BCTs are more or less conducive to being well understood depending on whether they are delivered in a group setting or an individualized one-one setting; for example some BCTs may require substantial one-one support that is difficult to deliver effectively to a large group with diverse needs. Further research across a wider range of interventions could aid understanding of this. It would also be valuable for future research to consider how participants' understanding of the BCT content of a program (receipt) may or may not change over time, that is, how understanding of a BCT persists (or not) from the end of a program to one year later.

Conclusions

Participants' understanding of the self-regulatory BCT content of the NHS-DPP is mixed and varied by BCT. It is likely that some BCTs such as "self-monitoring of behavior" are simply delivered better, though it is possible that some BCTs may be intrinsically more useful to people at high risk of T2DM. It is of concern that participants in the NHS-DPP do not receive sufficient support to help them understand and use some key self-regulatory BCT content of the programs such as "action planning". It is important to recognize where improvements can be made to the NHS-DPP, specifically in relation to how best NHS-DPP commissioning and monitoring arrangements can further improve delivery. This is imperative to ensure participants are able to understand the BCTs delivered and go on to achieve lasting behavior change.

Furthermore, we suggest that behavioral interventions more broadly consider building-in necessary support for participants to help them understand some BCTs such "action planning" and "problem solving". Future research is warranted to understand whether specific demographic characteristics of behavioral intervention recipients influence their understanding of BCTs.

Supplementary Material

Supplementary material is available at *Annals of Behavioral Medicine* online.

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Compliance with Ethical Standards

Authors' Statement of Conflict of Interest The authors declare that they have no conflicts of interest.

Ethical Approval All procedures performed were in accordance with the ethical standards of the North West Greater Manchester East NHS Research Ethics Committee (ref. 17/NW/0426) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Authors' Contributions L.M.M. collected and analysed the data, and prepared the manuscript. R.E.H. supported analysis of the data and helped to draft the manuscript. D.P.F. designed the research and secured funding for it as part of the wider DIPLOMA project. D.P.F. supervised the research conduct and helped to draft the manuscript. All authors read and approved the final manuscript.

Informed Consent It was obtained from all individual participants included in the study.

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