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Assessment of Motivational Cognitions in Diabetes Self-Care: The Motivation Thought Frequency Scales for Glucose Testing, Physical Activity and Healthy Eating

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Abstract

Purpose: There is a need for improved measurement of motivation for diabetes self-care. The Elaborated Intrusion Theory of Desire offers a coherent framework for understanding and identifying the cognitive-affective events that constitute the subjective experience of motivation, and may therefore inform the development of such an instrument. Recent research has shown the resultant Motivation Thought Frequency scale (MTF) to have a stable factor structure (Intensity, Incentives Imagery, Self-Efficacy Imagery, Availability) when applied to physical activity, excessive snacking, or alcohol use in the general population. The current study aimed to confirm the 4-factor structure of the MTF for glucose testing, physical activity and healthy eating in people with type 2 diabetes. Associations with self-reports of concurrent diabetic self-care behaviours were also examined.

Method: Confirmatory factor analyses tested the internal structure, and multiple regressions assessed the scale's relationship with concurrent self-care behaviours. The MTF was completed by 340 adults with type 2 diabetes, and 237 from that sample also reported self-care behaviours. Separate MTFs assessed motivation for glucose testing, physical activity and healthy eating. Self-care was assessed using questions from the Summary of Diabetes Self-Care Activities.

Results: The MTF for each goal achieved acceptable fit on all indices after selected errors within factors were allowed to intercorrelate. Intensity and Self-Efficacy Imagery provided the strongest and most consistent correlations with relevant self-care behaviours.

Conclusions: Results provide preliminary support for the MTF in a diabetes sample. Testing of its sensitivity to change and its predictive utility over time is needed.

Keywords: motivation; diabetes; assessment; self-management; imagery; cognition

Substantial, sustained efforts in multiple domains are required to effectively manage type 2 diabetes. Management typically involves modification of diet and physical activity to increase insulin sensitivity and reduce blood glucose levels [1, 2]. Frequent blood glucose testing is also recommended, to allow immediate responses to glucose fluctuations [3]. Initiating and maintaining such a complex and demanding regimen is heavily dependent on developing and sustaining motivation, which is key to establishing goal-directed behaviours [4, 5]. While adjustments to health behaviours are not inherently motivating [6], autonomous self-motivation can play a crucial role in adherence to a dietary regimen in diabetes [7]. However, motivation is inconsistently defined, measured and targeted in individuals with type 2 diabetes.

Existing theories of motivation to manage diabetes have portrayed motivation as a conscious process that provides a reason for, attitude toward, or a belief about executing self-care. For instance, Self-Determination Theory (SDT) [8] distinguishes between motivation that is self-initiated (intrinsic or autonomous) and motivation that is triggered by external punishment or reward (extrinsic or controlled). Assessment instruments modelled on this framework, such as the Treatment Self-Regulation Questionnaire (TSRQ) [9] assess respondents' attributions of internal and external reasons for engaging in a health behaviour. Such attributions are likely to be relatively stable over time, as they reflect an individual's values or goals. However, motivation is arguably a state variable that may wax and wane. Critical to the proximal impact of motivational cognitions is likely to be their recent intensity and frequency, and insufficient attention to these attributes is likely to limit the utility of an assessment instrument such as the TSRQ, especially over the short term [10, 11].

The Information-Motivation-Behavioural Skills Model (IMB) [12] proposes that behaviour is influenced by the possession of relevant information and skills, positive personal beliefs and attitudes about the target behaviour, and social support. This framework has informed the construction of the Diabetes Fatalism Scale (DFS) [13] which assesses perceptions of factors that may support motivation (e.g. that a particular action will produce a positive outcome), rather than directly measuring the strength of the person's motivation to engage in a particular behaviour. The DFS and other measurements of motivation grounded in the IMB model assess attitudes toward the health condition and the outcome of engaging in a self-care behaviour [14]. While beliefs in the ability to change and the effects of change are important, as argued in Protection Motivation Theory [15] and the Health Belief Model [16], they may be better conceptualised as precursors and correlates of motivation rather than indices of the degree of motivation itself.

This research proposes that motivation fluctuates in ways that are not accounted for by these theories and the scales based on them. The Elaborated Intrusion Theory of Desire (EI Theory) [10] provides an alternative framework for understanding motivated behaviour by focusing on motivational states over time. Desire for a goal is seen as an episodic experience involving cognitive elaboration of goal-related thoughts that in turn are determined by external cues, competing cognitive activities, and conflicting goals. EI theory was initially advanced in the context of psychoactive substance use [10, 17], but has been applied to a variety of other reward targets including food [18-20], and to behaviours such as physical activity [21]. It sees motivational states as affectively charged cognitions about a potential behaviour and its likely outcomes, which guide and sustain efforts toward a goal [18]. These cognitions are likely to have the strongest emotional charge, and be most effective at eliciting sustained efforts towards their target when they involve sensory imagery. The thoughts can be encoded in memory and retrieved later, giving a sense of motivational continuity. However, they are subject to renewed evaluation, and are therefore better conceptualised as states than traits. Since they comprise internal events, they are characterised by frequency, duration and availability or intrusiveness, and as affective experiences, by their intensity and valence. These cognitive-emotional events are triggered by associations with cues or other thoughts, or by physiological deficits. Individuals often lack insight into the triggers of desire [19,20] but the resulting thoughts and imagery-based elaborations are key components of the conscious experience of desire and therefore accessible to self-report.

The Craving Experience Questionnaire (CEQ) [22] applied these insights to the assessment of desires for a range of consummatory targets. Two forms were created, to assess the frequency of cognitions over a specified time period (e.g. in a laboratory session, or over a week), and the strength of the cognitions at a particular time (right now, or when the desire was strongest). Separate confirmatory factor analyses on each form of the CEQ revealed a 3-factor structure that was stable across specific targets (e.g. food, alcohol, cigarettes) and time periods. These were the *Intensity* of desire-related cognitions, desire *Imagery*, and perceived *Intrusiveness* of the cognitions.

More recently, CEQ items have been adapted to assess motivational cognitions for functional targets [21]. The frequency of these cognitions is measured by the Motivation Thought Frequency (MTF) scale, which currently focuses on the previous week. Some modifications were required to reflect a change in focus from a reward target to a behavioural goal. So, items relating to *Intrusiveness* (e.g. 'how hard were you trying not to think about it?') were substituted with items that did not imply that the thought was unwanted (e.g. 'how often did thoughts about it come to mind?') and the subscale was given the more neutral label *Availability*. Instead of the imagery items focusing on different sensory modalities (e.g. picture, taste), they now assessed imagery about positive outcomes (*Incentives Imagery*) and about successful attainments or strategies to reach the goal (*Self-Efficacy Imagery*) [23].

To date, the MTF has demonstrated a stable 4-factor structure (Intensity, Incentives Imagery, Self-Efficacy Imagery, Availability) across physical activity (MTF-PA) [21], high-calorie snacking (MTF-D [24]), and alcohol misuse (MTF-A [25]). MTF-PA subscales were strongly and positively associated with the Exercise Imagery Inventory Motivation subscale [26], a measure of the frequency of exercise-related imagery, with MTF imagery subscales showing particularly strong correlations (r = .62-.63, $p < .001$). Furthermore, the MTF-A total was positively associated with Action scores on the Readiness to Change Questionnaire (r = .55, $p < .001$) [25, 27]. In randomised controlled trials to reduce high-calorie snacking [28] and increase the frequency of gym attendance [29] the MTF-D and MTF-PA respectively showed sensitivity to change, and their change was positively correlated with changes in the relevant behaviour. These data suggest that the MTF is a psychometrically sound measure of motivation with potential relevance to a range of health behaviours.

The current study examined the performance of the MTF across 3 focal goals in type 2 diabetes. Specifically, the scales assessed the frequency of motivational cognitions for blood glucose testing (MTF-GT), physical activity (MTF-PA), and healthy eating (MTF-HE). The specific aims were to assess the MTF's internal structure and its degree of association with concurrent self-reports of diabetic self-care. MTF measures for diabetes were expected to each have the same EI theory 4-factor internal structure as established in previous research. Greater motivation, as indicated by higher scores on the MTF scales, was expected to be associated with greater concurrent adherence to relevant self-care behaviours, and to contribute additional predicted variance after control for gender and age. Collectively, these tests were expected to offer preliminary psychometric support for the application of the MTF scales to diabetes, and provide a foundation for subsequent tests of its sensitivity to change and ability to predict behaviours over time.

Method

Participants

A total of 340 participants with a self-reported health practitioner diagnosis of type 2 diabetes took part. Seventy percent of these (237) were recruited to participate in a randomised controlled trial examining the efficacy of a web program and related telephone intervention on diabetes self-care and dysphoria [30]. They were asked if they were trying to identify support to improve their diabetes self-management, and were promised self-guided modules to improve their diet, physical activity, health routines and mood, education and tips on self-management, and contact from researchers to support their self-management experience. The remaining 103 included ineligible RCT participants and adults with diabetes from the general community who were recruited through Australian diabetes support websites, and were invited to help the researchers find out their 'thoughts and feelings toward making lifestyle changes' by completing a survey. All participants reported receiving a diagnosis of type 2 diabetes at least 3 months previously, and facility with written English. Australian residency was a criterion for inclusion in the randomised controlled trial.

Materials

Motivation Thought Frequency (MTF). The MTF (Table 1) comprises 13 items, which were identical to those used in previous studies [21, 24, 25]. Each item assessed the frequency of motivational cognitions over the previous week, and used a 0-10 Likert scale ("never" to "constantly"). Items were administered with reference to glucose testing (MTF-GT), physical activity (MTF-PA) and healthy eating (MTF-HE).

Summary of Diabetes Self-Care Activities (SDSCA) [31]. Glucose testing, physical activity and healthy eating questions from the SDSCA were used to assess the frequency of adherence to these self-care behaviours. Scores comprised the number of days in the previous week (from 0 to 7) participants reportedly: (i) tested their blood sugar, (ii) participated in at least 30 minutes of physical activity, and (iii) ate five or more servings of fruits and vegetables. These questions were chosen due to their alignment with Australian National Health Guidelines, which recommend daily glucose testing [32], 2 serves of fruit and 5 serves of vegetables a day [33], and 30 minutes of moderate intensity activity (e.g. exercise, housework, gardening) on most days [34]. The baseline assessments for the RCT took approximately 1 hour to complete. Therefore, rather than administering the full scale, only selected questions from the SDSCA were included to reduce the burden of reporting on participants.

Short Fat Questionnaire [35]. Healthy eating was also measured by an Australian-normed 17-item survey about general consumption of fatty foods. Scores ranged from 0-63, with higher scores reflecting greater consumption of fat.

Insert Table 1 about here

Procedure

Ethical clearance was obtained from Queensland University of Technology's HREC (1400000268, 1100000783) and Uniting Care Queensland (Cassimatis9111). The MTF survey link was posted on social media sites, in e-newsletters and on the homepages of Diabetes Australia and its state associations in Queensland, Western Australia, South Australia, Tasmania and Victoria. Online consent was obtained at the beginning of the survey, and responses were recorded and stored using Key Survey™. In addition to the key measures reported above, the survey asked demographic questions. A self-report of the most recent test of glycated haemoglobin (HbA_{1c}) in the previous 4 weeks was also obtained if available.

Statistical analyses

Separate confirmatory factor analyses were applied to the MTF-GT, MTF-PA and MTF-HE using the lavaan package within R 3.2.4 [36]. To adjust for potential kurtosis and allow for missing item data, a robust maximum likelihood approach (MLR) was employed, and Yuan-Bentler adjustment was applied to correct for multivariate non-normality. Better fit was indexed by a reduced Akaike's Information Criterion (AIC), Standardised Root Mean Square (SRMR) and Root Mean Square Error of Approximation (RMSEA), and by an increased Bentler's Comparative Fit Index (CFI), and Tucker-Lewis Index (TLI). Good fit was defined by CFI and TLI > 0.90, and SRMR < 0.08, with acceptable fit comprising results that approached these criteria. Given the tendency for RMSEA to give highly variable results in moderate sized samples [37], a rigid criterion for acceptable fit on that indicator was not set. Modification indices were consulted to maximise model fit, and selected error terms for items within a factor were allowed to intercorrelate until good model fit was obtained or no further gains to fit were seen.

Mirroring the procedure used in the development of the MTF-PA [21], tests of the internal structure of each scale compared a single-factor model with models that related to the hypothesized factor structure. Since the hypothesised subscales may have collapsed into larger units (e.g. Intensity with Availability), 2-factor combinations reflecting these relationships were tested. A 3-factor model (Intensity, Availability and a single Imagery scale) and a 4-factor model that separated Incentives Imagery and Self-Efficacy Imagery were then tested. Modification indices were examined, to see whether additional benefit could be derived by correlating error terms within subscales. This serial process stopped when modification indices were < 20 and acceptable model fit was obtained. Factors were allowed to correlate in all models, reflecting our view that the subscales all related to a broad motivation measure. Reliabilities of the subscales are reported by coefficient omega (ω3, [38]), which uses the latent variables and the observed covariance matrix. However, coefficient alphas on the manifest variables are also given.

A repeated measures MANOVA using Wilks' Lambda on average MTF item scores, with age as a covariate, and Scale (3 levels) and Subscale (4 levels) as within-subjects variables, examined whether mean scores differed across those variables. Multiple regressions with forced entry were conducted to assess if MTF scores predicted relevant concurrent behaviour (glucose testing, physical activity, fruit/vegetable and fat consumption). Age and gender were controlled in these predictions and entered at the initial step, followed by the MTF subscales.

Results

There were no missing data on the MTF. Data screening revealed 29 multivariate outliers across the 3 scales using Mahalanobis *d*. These participants scored low on motivation in one MTF scale, but within the normal range in the other scales. In clinical practice it is not expected that patients will be highly motivated to manage all health behaviours, so these participants were included in the primary analyses.

Items tended to negative skew, indicating high average motivation. The MTF sample was aged between 27 and 84 ($M = 59.5$, $SD = 10.4$) and 58% were female. Average self-reported HbA_{1c} from the most recent blood test was 7.2%, or 55mmol/mol ($SD = 1.6$), 23% were insulin dependent, and 74% were taking oral diabetes medication.

The 237 participants who also completed the SDSCA were aged between 33 and 80 years ($M = 59.4$, $SD = 9.7$) and 54% were female. The average self-reported HbA_{1c} from the most recent blood test was 7.2% or 55mmol/mol (*SD* = 1.4), 21% were insulin dependent and 72% were taking blood glucose medication. Average SDSCA and Short Fat Questionnaire scores for the sub-sample are in Table 2. Older participant ages were weakly associated with greater self-reported adherence to fruit and vegetable guidelines ($r = .24$, $p < .001$), but all other self-care correlations were less than .15. Men ($M = 3.5$, $SD = 2.4$) had more days of physical activity per week than women ($M = 2.7$, $SD = 2.2$; $F(1, 235) = 7.46$, $p = .007$, $\eta^2 = .031$), but no other behaviours differed by sex.

Insert Table 2 about here

Internal structure of the MTF

The 4-factor internal structure that had been obtained in previous studies clearly provided better fit than the tested single, 2- and 3-factor models. Acceptable to very good fit was seen on all indices, especially when error terms within a factor were allowed to intercorrelate (Table 3).

Internal consistencies of the subscales were moderate to high for each MTF (Table 4), and while the single-factor model was not optimal, the total scales also had high internal consistency (MTF-GT: ω3 = .96, α = .95; MTF-PA: ω3 = .92, α = .92; MTF-HE: ω3 = .93, α = .92). Consistent with the latter result, MTF subscales showed moderate to high intercorrelations within each domain (Median *r* for MTF-GT = .74; MTF-PA = .62; MTF-HE = .62). In each case, the highest intercorrelations were between the two imagery subscales (Median *r* =.81). Table 4 also shows the intercorrelations between MTF subscales for different targets. The MTF-HE and MTF-PA subscales were the most closely related (Median

$r = .86$), and among subscales, Incentives Imagery showed the strongest correlations across behavioural targets (Median $r = .69$).

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Insert Tables 3-4 about here

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MTF average scores, and their relationships with gender and age

Mean scores for MTF subscales are displayed in Table 2. A repeated measures ANOVA with Gender as the between-subjects variable showed significant effects for MTF Scales ($F(2, 233) = 16.70$, $p < .001$, $\eta^2 = .125$), and Subscales ($F(3, 232) = 39.30$, $p < .001$, $\eta^2 = .337$), but not Gender ($F(1, 234) = 3.19$, $p = .075$, $\eta^2 = .013$). Glucose Testing had lower average cognition frequencies than Physical Activity or Healthy Eating, and Intensity subscales scored highest, while Self-Efficacy Imagery scored lowest. However, these effects were modified by significant interactions between each of the variables, reflecting the complex patterns in Table 2 (Scale x Subscale: $F(6, 229) = 9.64$, $p < .001$, $\eta^2 = .202$; Gender x Scale: $F(2, 233) = 8.79$, $p < .001$, $\eta^2 = .070$; Gender x Subscale: $F(3, 232) = 5.48$, $p = .001$, $\eta^2 = .066$; Gender x Scale x Subscale: $F(6, 229) = 2.62$, $p = .018$, $\eta^2 = .064$). Some statistically significant correlations were seen with age: these tended to be positive with Intensity (median $r = .17$), and negative with Availability subscales (median $r = -.14$), but none exceeded .20.

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Insert Table 5 about here

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Concurrent prediction of self-care behaviours

Concurrent predictions of glucose testing, physical activity, fruit and vegetable and fat consumption from content-relevant MTF subscales are in Table 5. Addition of the MTF subscales to predictions from Gender and Age were significant for all self-care behaviours ($p < .001$), contributing an additional 57% to the predicted variance for glucose testing, 24% for physical activity, 19% for fruit and vegetable consumption and 11% to fat intake. The most consistent individual subscale predictors were Intensity and Self-Efficacy Imagery, which both significantly correlated with all four self-care behaviours. The least consistent was Incentives Imagery, which only had a significant correlation with glucose testing.

Discussion

Confirmatory factor analyses on the Motivation Thought Frequency scales for glucose testing, physical activity and healthy eating in type 2 diabetes strongly supported the EI theory's prediction of a 4-factor internal structure, and were consistent with results of previous research on the MTF-PA [21], MTF-D [24], and MTF-A [25] in the general population. When error terms within a factor were allowed to intercorrelate, particularly good fit was demonstrated. Addition of MTF subscales to the equation significantly added to the concurrent prediction of all self-care behaviours ($p < .001$).

Frequencies of cognitions about wanting, needing or having a strong urge to undertake self-care behaviours (MTF Intensity) contributed unique predictive variance to all of the behaviours. These cognitions were also the most frequently reported on the MTF, and require less self-awareness than the specific identification of mental imagery, which may partly account for their predictive power in the current study.

While Self-Efficacy Imagery was recorded less frequently, it was also associated with the four self-care behaviours, and uniquely contributed to the prediction of all but physical activity. Close relationships with imagery about undertaking the behaviour were highly consistent with the predictive power of self-efficacy in diabetes [39, 40], and with the need to cue self-care behaviours by covert rehearsal.

While Availability had significant correlations with three of the self-care behaviours, it did not offer unique predictive variance, suggesting that its effects were better explained by other subscales. Furthermore, more frequent Incentives Imagery was only positively correlated with glucose testing. The lack of other significant predictions was unexpected, given the importance that imagery for incentives has in EI Theory and has shown in extensive related laboratory and clinical research on craving and desire [41]. The result may reflect a decreased power from Incentives Imagery over time, where repeated efforts to improve healthy eating or physical activity may not have resulted in substantial goal attainments (e.g. in weight or physical status). In contrast, incentives for blood sugar testing are more proximal and certain.

If the superior predictive effects from Intensity and Self-Efficacy Imagery are replicated in prospective research, assessment of motivations for diabetic self-care might perhaps be restricted to those subscales, which would substantially reduce the length of the assessment. However, effects from Incentives Imagery and Availability may be altered by an intervention that focused on elicitation of proximal and affectively strong forms of these cognitions.

The strongest concurrent associations of the MTF were with glucose testing. Ongoing monitoring of glucose is arguably the most critical aspect of self-care in diabetes, as it triggers subsequent self-care behaviours based on its results [3, 42]. However, while awareness of sugar levels is likely to trigger immediate actions to address hypo- or hyperglycemia, it may not always translate into improved self-care [43], so assessment of motivation for all three focal behaviours is preferable.

The weakest concurrent predictions involved dietary behaviours. The MTF-D used in previous research, which focused on high-calorie snacking [24], gave a more discrete focus than healthy eating. Additionally, increases in frequencies of cognitions about abstaining from high-calorie desserts, snacks and alcoholic drinks are associated with reductions in their consumption [28]. Neither of the dietary measures in the current study fully captured the concept of healthy eating; nor did they adequately capture the key components required to maintain stable glycaemic control. Refinement of the targets for dietary motivation and behaviours may provide stronger results in that domain.

The current study focused on the concurrent prediction of self-care behaviours, which prevents conclusions about the direction of any causal links. Research is therefore needed on the utility of the MTF as a prospective predictor of self-care. It is acknowledged that motivation can be unstable and that in this study the MTF focused on the previous week. Therefore it is expected that its primary predictive utility will involve proximal measures of self-care. Our predictions from the MTF may also have been enhanced by shared method variance, since both were by self-report. Future research should attempt to assess diabetes self-care more precisely and objectively (e.g., using event-cued recall of self-monitoring). Another limitation of the current study was that participants' self-reported diagnosis of diabetes and HbA_{1c} results were not verified by their treating clinician. In addition, time since diagnosis was not controlled. The absence of statistical control for disease duration may have restricted identification of associations between the MTF and self-care, among participants with relatively recent and more long-standing diabetes. The MTF may have greater relevance at critical stages of the disorder (e.g. soon after diagnosis or a glycaemic crisis) than at other times. Motivational cognitions may not be needed to sustain well-established habits (although they may retain importance when routines are interrupted or situational challenges to self-care are encountered). Accordingly, effects of both duration and recent diabetic events should be measured in future research. Finally, participants were self-selected and most were already linked with support agencies, which may indicate higher than average motivation to manage their health. Performance of the MTF should also be tested in a random clinic sample where variability in motivation and diabetic status may be greater.

Unlike previous motivation scales, the MTF provides a measure of the frequency of recent motivational cognitions, regardless of the source of that motivation. In combination with existing research in the general population, this study suggests that the MTF may be applied to a variety of goals and in a wide range of contexts. In the management of diabetes, the MTF may be used in routine assessments in combination with measures of self-care, to alert patients to any deterioration, determine whether referral for adherence support is needed, and identify behavioural and motivational foci for intervention. Where motivation is strong but self-care is sub-optimal, treatment could primarily focus on strategies to improve self-care.

The present study provides strong preliminary evidence in support of MTF scales as measures of motivational cognitions about adherence to diabetes self-management regimens. If the MTF demonstrates similar sensitivity to change as it has demonstrated in other contexts [28, 29], it may also be used to measure the impact of motivational interventions in diabetes. Demonstration of these features will further substantiate the utility of the MTF scales in routine diabetic care.

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Compliance with Ethical Standards:

Conflict of Interest: The authors declare that they have no conflict of interest.

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

This article does not contain any studies with animals performed by any of the authors.

Informed consent: Informed consent was obtained from all individual participants included in the study.

Table 1. Items on the Motivation Thought Frequency Scales

Intensity	
Over the last week, how often did you…	
1.	…feel you wanted to…
2.	…feel you needed to…
3.	…have a strong urge to…
Incentives Imagery	
Over the last week, how often did you…	
4.	…imagine how good it would be to…
5.	…imagine how much better you'd feel if you…
6.	…imagine how much worse you'd feel if you didn't…
Self-Efficacy Imagery	
Over the last week, how often did you…	
7.	…imagine yourself…
8.	…imagine how you would…
9.	…imagine succeeding at…
10.	…picture times you did something like these in the past…
Availability	
Over the last week, how often did…	
11.	…thoughts about…come to mind
12.	…other things remind you about…
13.	…thoughts about…grab your attention

Note. Each item related to testing blood glucose regularly, keeping active and eating healthily. Responses were rated from 0 (never) to 10 (constantly).

Table 2. Descriptive Statistics for Baseline Motivation Thought Frequency Scales and Self-Care Behaviours

Measure		Total Score		
		Men	Women	Total
		M (SD)	M (SD)	M (SD)
Self-Reports of Self-Care				
Glucose Testing (days/week tested)		4.8 (2.7)	4.2 (2.7)	4.5 (2.7)
Physical Activity (days/week with 30 mins activity)		3.5 (2.4)	2.7 (2.2)	3.0 (2.3)
Fruit/Vegetable consumption (days/week with ≥ 5 serves)		4.4 (2.0)	4.7 (2.0)	4.5 (2.0)
Fat intake (usual consumption on Short Fat Questionnaire)		19.4 (7.0)	18.8 (6.4)	19.0 (6.7)
Motivation Thought Frequency (MTF) scale for diabetes		Mean (SD) item score (0—never to 10—constantly)		
Glucose Testing	Intensity	6.9 (3.0)	6.2 (2.9)	6.5 (3.0)
	Incentives Imagery	5.3 (3.3)	5.7 (3.3)	5.5 (3.3)
	Self-Efficacy Imagery	5.4 (3.3)	5.2 (3.1)	5.3 (3.2)
	Availability	4.9 (3.2)	5.1 (3.3)	5.0 (3.2)
Physical Activity	Intensity	7.2 (2.1)	6.8 (2.1)	7.0 (2.1)
	Incentives Imagery	6.0 (2.8)	7.0 (2.7)	6.5 (2.8)
	Self-Efficacy Imagery	5.6 (2.7)	5.9 (2.5)	5.8 (2.6)
	Availability	5.7 (2.7)	6.7 (2.5)	6.3 (2.6)
Healthy Eating	Intensity	7.3 (2.0)	7.6 (1.9)	7.4 (1.9)
	Incentives Imagery	5.9 (3.0)	7.0 (2.6)	6.5 (2.9)
	Self-Efficacy Imagery	5.4 (2.8)	6.3 (2.4)	5.9 (2.7)
	Availability	5.5 (2.7)	7.0 (2.3)	6.3 (3.0)

Table 3. Confirmatory Factor Analysis of the Motivation Thought Frequency Scales for Diabetes

	Yuan-Bentler χ^2	df	CFI	TLI	AIC	SRMR	RMSEA	90%CI
Glucose Testing								
1 factor	571	65	.784	.740	20569	.078	.151	.143-.160
2 factors (Intensity/Availability, Imagery)	552	64	.791	.746	20516	.075	.150	.141-.159
2 factors (Intensity/Imagery, Availability)	507	64	.810	.769	20441	.076	.143	.134-.152
2 factors (Intensity, Imagery/Availability)	337	64	.883	.857	20169	.055	.112	.103-.122
3 factors (Intensity, Imagery, Availability)	276	62	.909	.885	20063	.052	.101	.091-.111
4 factors (Intensity, Incentives Imagery, Self-Efficacy Imagery, Availability)	225	59	.929	.906	19982	.050	.091	.081-.101
Correlating errors for Items 7/8, 12/13	185	57	.945	.925	19918	.042	.081	.070-.092
Physical Activity								
1 factor	554	65	.715	.658	20624	.103	.149	.139-.158
2 factors (Intensity/Availability, Imagery)	523	64	.732	.673	20564	.100	.145	.136-.155
2 factors (Intensity/Imagery, Availability)	487	64	.753	.699	20519	.101	.139	.130-.149
2 factors (Intensity, Imagery/Availability)	348	64	.854	.798	20317	.078	.114	.105-.124
3 factors (Intensity, Imagery, Availability)	287	62	.869	.835	20225	.076	.103	.093-.114
4 factors (Intensity, Incentives Imagery, Self-Efficacy Imagery, Availability)	217	59	.908	.878	20127	.069	.089	.078-.100
Correlating errors for Items 12/13, 7/8	177	57	.930	.904	20071	.061	.079	.068-.090
Healthy Eating								
1 factor	530	65	.736	.684	20205	.097	.145	.136-.154
2 factors (Intensity/Availability, Imagery)	504	64	.750	.696	20142	.093	.142	.133-.152
2 factors (Intensity/Imagery, Availability)	454	64	.779	.731	20086	.094	.134	.124-.143
2 factors (Intensity, Imagery/Availability)	316	64	.857	.826	19874	.070	.108	.098-.117
3 factors (Intensity, Imagery, Availability)	240	62	.899	.873	19765	.066	.092	.082-.102
4 factors (Intensity, Incentives Imagery, Self-Efficacy Imagery, Availability)	195	59	.923	.898	19697	.062	.082	.072-.093
Correlating errors for Items 12/13, 7/8	185	57	.928	.901	19680	.059	.081	.070-.092

Table 4. Internal Consistency and Intercorrelations of the Motivation Thought Frequency Subscales[1]

	Glucose Testing				Physical Activity				Diet			
	Imagery				Imagery				Imagery			
Target	Intensity	Incentives	Efficacy	Availability	Intensity	Incentives	Efficacy	Availability	Intensity	Incentives	Efficacy	Availability
Glucose Testing												
Intensity	.92 (.92)[1]											
Incentives	.59***	.89 (.91)[1]										
Efficacy	.70***	.85***	.88 (.88)[1]									
Availability	.56***	.81***	.78***	.85 (.89)[1]								
Physical Activity												
Intensity	.36***				.86 (.85)[1]							
Incentives		.67***			.31***	.81 (.80)[1]						
Efficacy			.57***		.55***	.76***	.81 (.84)[1]					
Availability				.55***	.37***	.70***	.68***	.75 (.84)[1]				
Healthy Eating												
Intensity	.34***				.67***				.88 (.86)[1]			
Incentives		.69***				.92***			.39***	.77 (.77)[1]		
Efficacy			.62***				.86***		.57***	.81***	.89 (.90)[1]	
Availability				.54***				.86***	.37***	.68***	.67***	.76 (.83)[1]

*** $p < .001$

1. Reliabilities are on the diagonal. The first number is ω3 (Raykov, 2001), which uses the latent variables and the observed covariance matrix, and the number in parentheses is coefficient alpha on the manifest variables.

Table 5. Concurrent Predictions of Weekly Self-Management Behaviours

Predicted Self-Care Behaviour	Predictors	Univariate correlations		Changes at each Step				Equation at final step		
		r	*p*	R^2 Change	*F* Change	df	*p*	*β*	SE	*p*
Glucose Testing	Constant	…	…					.314	.891	.725
	Age	.113	**.041**					-.004	.013	.743
	Gender	-.106	.051	.021	2.495	2,231	.085	.006	.242	.979
	MTF-GT Subscales									
	Intensity	.757	**< .001**					.221	.019	**< .001**
	Incentives Imagery	.401	**< .001**					.064	.025	**.011**
	Self-Efficacy Imagery	.551	**< .001**					-.051	.021	**.014**
	Availability	.439	**< .001**	.568	78.31	4,227	**< .001**	006	.021	.793
Physical Activity	Constant	…	…					-.054	1.051	.959
	Age	.13	**.022**					.004	.014	.797
	Gender	-.18	**.003**	.042	5.10	2,231	**.007**	-.578	.273	**.035**
	MTF-PA Subscales									
	Intensity	.51	**< .001**					.191	.025	**< .001**
	Incentives Imagery	.05	.219					.014	.027	.596
	Self-Efficacy Imagery	.18	**.003**					-.018	.022	.428
	Availability	.09	.086	.240	18.93	4,227	**< .001**	-.005	.026	.841
Fruit/Vegetable Consumption	Constant	…	…					-0.847	.927	.362
	Age	.24	**< .001**					.044	.012	**< .001**
	Gender	.06	.168	.065	7.97	2,231	**< .001**	.219	.243	.369
	MTF-HE Subscales									
	Intensity	.39	**< .001**					.082	.024	**.001**
	Incentives Imagery	.07	.139					-.094	.025	**< .001**
	Self-Efficacy Imagery	.28	**< .001**					.072	.021	**.001**
	Availability	.19	**.002**	.185	14.00	4,227	**< .001**	.038	.024	.114
Fat Consumption	Constant	…	…					27.477	3.330	< .001
	Age	-.06	.196					- .013	.045	.765
	Gender	-.05[a]	.239	.006	0.71	2,231	.490	-.442	.874	.614
	MTF-HE Subscales									
	Intensity	-.32	**< .001**					-.279	.087	**.002**
	Incentives Imagery	-.11	.053					.107	.089	.232
	Self-Efficacy Imagery	-.24	**< .001**					-.162	.075	**.031**
	Availability	-.11	**.040**	.112	7.21	4,227	**< .001**	.054	.085	.530

[a] The displayed correlations are as used in the multiple linear regression. Tests for Gender using ANOVAs were, for Glucose testing: F (1, 235) = 2.69, p = .103; Physical activity: F (1, 235) = 7.46, p = .007; Fruit/vegetable consumption: F (1, 235) = 0.93, p = .337; and Fat consumption: F (1, 235) = 0.50, p = .479.
Probabilities < .05 are in bold type.