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**Functional Imagery Training to reduce snacking: Testing a novel motivational intervention based on Elaborated Intrusion theory**

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## Highlights

1. Tests Functional Imagery Training, a new, theory-based intervention for changing eating behaviours
2. Following Functional Imagery Training, snacking reduced and participants lost weight
3. Snacking reductions and weight loss correlated with increases in motivational thought frequency

### **Abstract**

Functional Imagery Training (FIT) is a new theory-based, manualized intervention that trains positive goal imagery. Multisensory episodic imagery of proximal personal goals is elicited and practised, to sustain motivation and compete with less functional cravings. This study tested the impact of a single session of FIT plus a booster phone call on snacking. In a stepped-wedge design, 45 participants who wanted to lose weight or reduce snacking were randomly assigned to receive a session of FIT immediately or after a 2-week delay. High-sugar and high-fat snacks were recorded using timeline follow back for the previous 3 days, at baseline, 2 and 4 weeks. At 2 weeks, snacking was lower in the immediate group than in the delayed group, and the reduction after FIT was replicated in the delayed group between 2 and 4 weeks. Frequencies of motivational thoughts about snack reduction rose following FIT for both groups, and this change correlated with reductions in snacking and weight loss. By showing that FIT can support change in eating behaviours, these findings show its potential as a motivational intervention for weight management.

*Keywords:*

Cognitive, psychological, motivation, behaviour change, craving, snacking

Obesity is endemic, with over half of the adult population in OECD countries (OECD, 2014) and an estimated 1.9 billion adults worldwide being overweight or obese (WHO, 2015). Snacking between meals on foods high in fat, sugar or simple carbohydrate is associated with obesity (Booth, 1988; Basdevant, Craplet & Guy-Grand, 1993; Bertéus Forslund et al., 2005; Nicklas, O'Neil & Fulgoni, 2014), except when snacking on carbohydrates is linked to reduced meal size (Drummond, Crombie, Cursiter, & Kirk, 1998).

A contributing factor to high calorie snacking is craving (Chao, Grilo, White, & Sinha, 2014; Gilhooly, et al., 2007), which is not synonymous with true hunger (Lafay et al., 2001). Such cravings and desires are often triggered by external cues about snacks, or internal cues such as associated thoughts, hunger, or affective states including boredom (May, Andrade, Panabokke & Kavanagh, 2004). Elaborated Intrusion (EI) theory (Kavanagh, Andrade, & May, 2005) describes how these triggers lead to initial intrusive thoughts that capture attention, and are then elaborated, creating the craving episode and triggering consciously directed acquisition of the target. Desires are typically characterized by sensory imagery, especially when they are intense (May, Kavanagh, & Andrade, 2015). When asked to describe a specific craving at the time that it is occurring, May et al., (2004) found 70% reporting that the thoughts were spontaneous, 65% 'imagined the smell/taste', and 59% 'pictured myself having it'. In contrast, fewer reported that cravings occurred due to seeing or smelling the target (34%), habit (29%), or negative mood (28%).

EI theory also predicts that imagery may be used to sustain motivation for healthy goals (Andrade, May, & Kavanagh, 2012). Generally, healthy goals tend to be more distant and therefore construed more holistically, with less specific detail,

than short-term pleasures such as the satisfaction of giving into food cravings (Trope & Liberman, 2010). This means that naturally occurring imagery for functional goals typically lacks the sensory detail to be as vivid and emotionally compelling as craving imagery.

EI theory predicts that strategies to strengthen goal imagery will increase goal desire and goal attainment (May, Andrade, Kavanagh, & Hetherington, 2012). There is evidence that instructions to imagine acting out a goal can enhance the effect of implementation intentions (Knaüper, Roseman, Johnson, & Krantz, 2009), and delay discounting tasks have shown similar benefits of imagery (Kim, Schnall & White, 2011; Daniel, Stanton & Epstein, 2013). In weight management, imagery training may be key to making healthy eating goals more vivid, proximal and available.

We have developed an intervention—Functional Imagery Training (FIT)—that uses imagery to enhance motivation (Andrade, et al., 2012; Kavanagh, Andrade, May, & Connor, 2014; May, et al., 2012; initially FIT was called Functional Decision Making, but the revised title emphasizes the centrality of imagery and the focus on training for self-management). The potential to change behaviour by supporting motivation is shown by a meta-analysis of eleven randomized controlled trials of motivational interviewing (Miller & Rollnick, 2012) for weight loss: adults with overweight or obesity who received motivational interviewing were more likely to have lost weight than a control group (Armstrong, 2011). A meta-analysis of five studies by Van Wormer and Boucher (2004) also found motivational interviewing to be more effective than nutritional education in changing eating habits to reduce fat and salt intake and increase fruit consumption. However, effect sizes were modest, indicating scope for improvement.

Like motivational interviewing, FIT is delivered in client-centred counselling style that creates a context where people are encouraged to consider the utility and possibility of functional behaviour change. Uniquely to FIT, clients are guided through a series of mental imagery exercises and trained to practice imagery at home. Clients thus use imagery rather than verbalization to explore their goals, problems and potential solutions. Large, distant goals, such as being healthier, are deconstructed into smaller, proximal goals that are more concrete and are more easily and vividly imagined. A central tenet of FIT is that vivid, highly valued goal imagery will compete with craving imagery at key decisional moments, such as when we choose between eating some carrot sticks or a chocolate bar (May et al., 2012). EI theory explains that thoughts about tempting foods lead to more vivid and affective imagery than the healthy goal, and so the decision between consumption and abstention is biased towards short-term, unhealthy choices. To make healthy goals more vivid, proximal and concrete, FIT encourages clients to list and imagine the benefits of working towards their goals, focusing particularly on benefits that are expected to happen right away (e.g., feeling good about oneself). By practising imagery about healthy goals, the benefits of these goals become more salient, and more likely to come to mind when faced with temptation. Associating the goal imagery with everyday activities enhances this availability through rehearsal, and associating it with the same cues that accompany temptation makes it more likely to be recalled when temptation strikes.

To increase self-efficacy, clients imagine past successes in reducing snacking, or achieving other self-control goals, and imagine applying those strategies to their current situation. Importantly, eliciting memories of past success provides personal, episodic detail to increase the vividness of imagery about future

success. Clients are helped to develop a plan for working towards their goal, using imagery to increase the likelihood of achieving the goal (Knäuper et al., 2009; Knäuper, Pillay, Lacaille, McCollam, & Kelso, 2011) by making their plan detailed and concrete, increasing confidence that it is achievable, and anticipating the feeling of reward on achieving the goal. Clients are taught goal imagery as a skill to practise at home, initially cued using a frequent, routine behavior, and also with personal photographs, until it becomes habitual.

This paper reports a preliminary test of FIT as motivational support for dietary change. Specifically, we test the impact of FIT on high-calorie snacking. Participants received FIT either at baseline or after a 2-week delay. We predicted that reductions in snacking, and increases in the frequency of motivational cognitions, would occur in the period following delivery of the FIT intervention, i.e., between baseline and 2 weeks for the immediate condition and between 2 and 4 weeks for the delayed condition. As the study was presented to participants as testing a novel weight-loss intervention, and they were recruited on the basis that they wished to lose weight, we also measured weight at each session.

We do not compare FIT in this study with MI, as our aim is to follow the advice of Craig et al. (2008) to demonstrate that an intervention has some value over the 'treatment as usual' before moving on to 'fine-tuning'. In the case of attempts to change dietary behaviours, there is no 'treatment as usual' as most people who seek to lose weight do so without seeking professional intervention, and this is even more the case for those who want to change a single aspect of their diet such as cutting snacks. If people receive any intervention for weight management, this is typically brief advice and general information. Booth, Prevost and Gulliford (2015) reported that 90% of over 90,000 overweight or obese patients had had no weight

management interventions recorded, and that 'lifestyle advice was the most commonly used intervention in all but the morbidly obese patients'. The Counterweight study (2004) reported that only 25% of obese patients received any intervention, and that 80% of these received practice-based diet counselling. However, to provide a stronger test of FIT as a specific motivational intervention, we gave all participants similar brief advice and a leaflet on 'healthy eating' in the first session. Simply joining a trial can be motivating but this motivation can be counteracted by the disappointment of finding oneself in a 'do nothing' control condition. Providing materials for everyone at the start hopefully averted any disappointment, testing better whether FIT added something over and above the motivational boost of starting a trial. By ensuring that all participants had information about healthy diet choices, positive effects of FIT on snacking behaviour could be interpreted as effects on motivation to eat healthily rather than on knowledge about what constitutes healthy eating.

## **Method**

### *Participants*

Forty-five participants (39 female, 6 male) aged 18-67 (M=29.6) were recruited using advertisements placed around the University campus for people who wanted to lose weight and reduce their snacking (attempts to recruit people on the basis solely of wanting to reduce snacking were unsuccessful). Participants had a mean baseline BMI of 26.5, (Range =19.7- 44.8), with 21 (47%) being at or above the healthy upper limit of 25; nine of these exceeded 30. Self-reported history of eating disorders or excessive use of alcohol constituted exclusion criteria. Eighteen participants were volunteers from the general public who had the chance of winning one of five £20 Amazon vouchers as an incentive to take part, and 27 were

psychology undergraduates who received points towards their course requirement to take part in research. Participants were randomly allocated to an immediate FIT (N=24) or delayed FIT condition (N=21).

### *Design*

We used a stepped-wedge design (Craig, et al., 2008; Hussey & Hughes, 2007), in which an intervention is rolled out over time in different groups. The immediate FIT group received FIT in their first session (after baseline measurements) and the delayed FIT group received FIT in their second session after a 2-week delay. Both groups were assessed in a third session after 4 weeks. This design should help improve retention and compliance in the 'control' (delayed intervention) group, with the promise of receiving an intervention keeping participants interested and discouraging them from seeking other sources of support following the initial boost to motivation that they might get from signing up for a trial. Control comparisons are possible both within groups (over time) and between groups (at session 2), and can be detected through an interaction of session and group.

### *FIT Intervention*

After acknowledging the participant's wish to lose weight, the experimenter suggested a focus on 'high-calorie desserts or snacks and sugary or alcoholic drinks', and asked if any of those were producing any issues for them (the full script is available in the Supplementary Materials). They were asked about any improvements they might see after a year, and then after a week, if they cut down their snacking. After summarizing those issues and eliciting their emotional response, participants were given a brief practice task in which they were asked to imagine cutting a lemon, to clarify what was meant by mental imagery in different

sensory modalities such as vision, touch, taste and smell, and to demonstrate links between imagery and emotion (such as surprise when some juice squirts into their eye). This example, taken from Holmes & Mathews (2005), is commonly used in mental imagery research. They then silently imagined a specific occasion when they were likely to experience positive changes after reducing their snacking for a year, while the experimenter provided prompts to accentuate the sensory and emotional effects of the imagined episode, and then described and rated the image from 1 (no image) to 10 (extremely vivid).

Participants were asked what action they might like to choose, and rated their confidence in reducing their snacking in this way for at least a week (from 0%, I can't do it, to 100%, sure I can do it). They relived a memory of a time when they reduced their snacking, or succeeded with another self-control goal, and then considered whether any successful strategies from that time could be used now. They imagined getting started with their goal, and solving any challenges, before re-rating their confidence, and articulating a plan for the next few days.

Participants were asked to identify a routine, frequent behaviour, such as hand washing or climbing stairs, which they could use to cue imagery practice at home. The experimenter asked them to carry out this behaviour in the lab, while imagining how they would stay in control of snacking in the next hour, and how good it would feel to succeed. They were encouraged to practise the imagery whenever they undertook the routine behavior, and to set reminders on their phone to practise before a situation that would challenge their control. They were also encouraged to take photos to remind them to create images of specific positive effects from being in control.

## *Assessments*

### *Snacking.*

Participants reported all between-meal consumption of food and drink, and desserts taken with meals, over the previous 3 days using a Timeline Follow Back (TLFB; Sobell & Sobell, 1992). Originally developed to assess alcohol and drug use, this retrospective method asks participants to recall consumption during specific periods, using other cues from their life or routine to cue episodic memories, and has been shown to have high reliability and validity when delivered face-to-face or online (Pedersen, Grow, Duncan, Neighbors, & Larimer, 2012). It is less intrusive than having to complete daily diaries or respond to text message prompts during the day, avoids reactivity of assessment and issues with adherence to monitoring, and shows comparable levels of accuracy (e.g., Brown, et al., 1998; Lewis-Esquerre, et al., 2005).

We adapted the TLFB method to ask participants to recall snacking between meals by asking them what they had done during the morning, afternoon, and evening of each of the previous three days, to cue memories of anything that they had eaten or drunk between breakfast and lunch, between lunch and their evening meal, and between their evening meal and bedtime. They also reported how confident they were in their accuracy, from 0 (not at all) to 10 (completely). Snacks were defined on the TLFB as “any food or drink that is high in sugar, fat or alcohol. Examples include sugary soft drinks, fruit juices, alcoholic drinks, chocolates, cakes, desserts, and crisps, even if they are part of a meal.” Participants were asked to “Think about what you did yesterday [AFTERNOON] and jot a few notes down in this box to remind yourself”. Yes/no questions followed: “Did you have a snack in the afternoon, before your evening meal? Remember, this includes a dessert with lunch”

and “Did you have a sugary or alcoholic drink in the afternoon, before your evening meal? Remember, this includes a drink with lunch”. Where participants answered “yes”, they were asked to specify what and how much they consumed.

The TLFB reports were sorted alphabetically and two judges (JM and JA), who were blind to the group or session assignment, independently scored the number of snacks consumed. Snacks were defined as high-fat or high-sugar foods eaten between meals or as dessert following a meal, and any high-sugar or alcoholic drinks. Cereal bars high in fat or sugar were classed as snacks, but any items low in sugar and fat such as sugar-free soft drinks, diet bars, diet yoghurt, nuts and fruit were not (while nuts have significant fat content and fruit contains fructose, these were seen as healthier alternatives to commercial snacks). Unspecified plurals and modifiers such as ‘a few’ were systematically counted as 3 items, while a whole pizza was counted as 6, a half-litre bottle of soft drink or a pint of beer as 2, a bottle of wine as 6 and a bottle of spirits as 24. Snacks were self-defined in the sense that foods such as pizza, which could be eaten as a meal, were counted as snacks if participants reported them on the TLFB (Jahns, Siega-Riz & Popkin, 2001). Each TLFB thus provided totals of high-energy snacks eaten as dessert or between meals, and high-energy drinks taken with or between meals, over a three-day period (Consumption), and the number of occasions on which any such snacking had occurred (Occasions: 0-9, i.e., 3 meal/between-meal periods over 3 days).

*Motivational Thought Frequency-Diet (MTF-D)*. The *MTF-D* assesses the frequency of motivational thoughts about one’s diet – here it focused on cutting down on snacks – and is based upon the *MTF-Exercise* for increasing physical activity (Kavanagh, et al., under review) and the *MTF-Alcohol* for reducing problematic alcohol consumption (Robinson, et al., under review). Wording of the items of the

MTF has been based on the Craving Experience Questionnaire (CEQ; May et al., 2015) and the Alcohol Craving Experience questionnaire (ACE; Statham, et al. .2011), which in turn were informed by EI theory, and includes items that address the frequency of motivational thoughts and images, and their availability.

The scale that we used began ‘Thinking about snacking less, please select a number from 0 (not at all) to 10 (constantly) to answer these questions’ and was followed by fourteen items such as ‘Over the last week, how often did you feel you wanted to do it?’, ‘Over the last week, how often did you imagine yourself doing it?’, and ‘Over the last week, how often did other things remind you about doing it?’. Each item was presented alongside the numbers 0 to 10, arranged linearly as a visual analog scale (see Supplementary Materials).

### *Procedure*

The study was approved by Plymouth University Faculty of Health and Human Sciences Ethics Committee. Participants gave written informed consent and were tested individually by authors MK or JD. Each participant attended three meetings: a baseline meeting, followed by meetings after 2 and 4 weeks. At the Baseline meeting, participants’ sex, age, height and weight were recorded, and they were asked when they snacked most and why they would like to cut down. They completed the MTF-D and TLFB to report snacks over the previous 3 days, rating how confident they were in the accuracy of their report, from 0 (not at all) to 10 (completely). All participants were given a healthy eating leaflet (Kenny & Sambrook, 2014), including information on food groups, benefits of a healthy diet, and risks of eating too much sugar, fat and salt.

Participants in the immediate condition then had their FIT session, which lasted around 40 mins. After 1 week, the immediate condition received a telephone

call lasting about 10 minutes, which asked about their imagery practice. If they had forgotten to practise, the experimenter readministered the goal imagery exercise.

At 2 weeks, all participants were reweighed, and completed the MTF-D and TLFB a second time. They rated how effective they found the healthy eating leaflets (not at all effective, 0, to very effective, 10), and those in the immediate condition rated how effective they found FIT, how often they carried out the imagery, and how useful the booster call was. Participants in the delayed condition then received FIT, with a booster call a week later.

At 4 weeks, all participants were reweighed and again completed the MTF-D and TLFB. Ratings of FIT were obtained from all participants at this point, allowing the impressions of the delayed group to be compared with those provided by the immediate group in their week 2 session.

We weighed participants before they completed the questionnaires in each session because, although weight loss was not a hypothesised outcome, participants had been recruited on the basis that they wished to lose weight. Weighing them at the start of each of the three sessions supported this framing of the study; we did not record how often they weighed themselves outside the experimental sessions.

## **Results**

There was no difference in BMI between immediate ( $M=26.3$ ) and delayed ( $M=26.7$ ) FIT,  $t(43)=0.23$ ,  $p=.82$ . At the baseline session, participants reported that the most frequent contexts for snacking were when procrastinating ( $N=26$ , 58%), just before or after meals ( $N=21$ , 47%), between busy periods of the day ( $N=22$ , 49%), and when they missed a meal ( $N=20$ , 44%). When asked why they would like to cut down on snacking, the majority reported wanting to lose weight ( $N=39$ , 87%), and feel healthier ( $N=38$ , 84%). Thirty participants (67%) reported that they were actively

trying to reduce their snacking before the study began, 19 (79%) in the immediate FIT condition, and 11 (52%) in the delayed FIT condition ( $\chi^2(1)=3.62, p=.057$ ).

#### *FIT session and follow-up*

Engagement in the FIT interview was shown by the high vividness of imagery ratings on the 1-10 scale, at both the first ( $M=7.3, SD=1.5$ ) and second rating point ( $M=6.5, SD=1.9$ ). ANOVA with the factors of Condition and Time showed that self-efficacy ratings increased following imagery, from 71% ( $SD=14\%$ ) to 75% ( $SD=14\%$ ) ( $F(1,43)=5.74, p=.021, \eta_p^2=.12$ ), with no interaction with condition ( $F < 1$ ).

Two weeks after their FIT session, participants gave moderate to high ratings on 0-10 scales to the effectiveness of FIT ( $M=6.3, SD=1.8$ ), the usefulness of the later phone call ( $M=7.0, SD=1.8$ ), and the extent they practised imagery ( $M=5.4, SD=2.2$ ). None of these measures differed between conditions (all  $ps > .70$ ).

#### *Snacking*

Mean confidence in accuracy of TLFB reports ranged from 5.33 to 10 ( $M=8.0, SD=1.2$ ). From the immediate FIT condition, one participant missed the 2-week TLFB report and one the 4-week TLFB report: these missing values were replaced by the means from their other two reports.

Consumption and Occasions were entered into a 2 (condition) x 3 (time) MANOVA, which showed that snacking reduced over time (Pillai's trace=.42,  $F(4,40)= 7.23, p < .001, \eta_p^2=.42$ ), from an overall mean of 11.6 items on 5.7 occasions reported at baseline to 7.0 items on 3.8 occasions reported at the 4 week session, by which time all participants had received FIT. As predicted, an interaction was found between time and condition (Figure 1; Pillai's trace=.23,  $F(4,40)= 2.95, p=.032, \eta_p^2=.23$ ), due to a difference between the two groups' snacking reported at the 2 week session.

To evaluate the prediction that changes in snacking would be temporally related to delivery of FIT, a separate MANOVA was conducted to compare Consumption and Occasions for the meetings immediately before and after the FIT delivery. As expected, both measures reduced between these two meetings (Pillai's trace=.42,  $F(2,42)=15.22$ ,  $p<.001$ ,  $\eta_p^2=.42$ ), with univariate effects for both variables (Occasions:  $F(1,43)=19.23$ ,  $p<.001$ ,  $\eta_p^2=.31$ ; Consumption:  $F(1,43)=28.08$ ,  $p<.001$ ,  $\eta_p^2=.40$ ). Reduction from before FIT to after FIT did not vary by condition (Pillai's trace=.06,  $F(2,42)=1.27$ ,  $p=.29$ ,  $\eta_p^2=.06$ ). Planned comparisons confirmed that at the 2-week assessment, the immediate FIT group reported consuming fewer snacks (Immediate  $M=7.4$  (5.3), Delayed  $M=12.7$  (9.0),  $t(43)=2.42$ ,  $p=.020$ ) on fewer occasions (Immediate  $M=4.0$  (2.1), Delayed  $M=5.4$  (2.2),  $t(43)=2.28$ ,  $p=.028$ ) than the delayed group, but neither measure differed between conditions at baseline or 4 weeks.

Separate MANOVAs for each condition showed effects of session on both measures in both conditions. Between baseline and 2 weeks, participants receiving immediate FIT decreased consumption ( $F(1,23)=12.2$ ,  $p=.002$ ,  $\eta_p^2=.35$ ) and snacking occasions ( $F(1,23)=10.5$ ,  $p=.004$ ,  $\eta_p^2=.31$ ): neither measure changed between week 2 and week 4 ( $F_s < 1$ ). Participants in the delayed FIT condition showed no changes between baseline and week 2 for either measure ( $F_s < 2$ ), but both measures decreased when they received FIT after week 2 (Consumption:  $F(1,20)=15.2$ ,  $p < .001$ ,  $\eta_p^2=.43$ ; Occasions:  $F(1,20)=8.77$ ,  $p=.008$ ,  $\eta_p^2=.21$ ).

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Insert Figure 1 about here.

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### *Motivational Thought Frequency-Diet (MTF-D)*

In the baseline session, the MTF-D produced a Cronbach's alpha of .92, and scores did not differ between conditions ( $t(43) = 0.30, p=.76$ ).

Frequency of thoughts about snacking less increased over time from an overall mean of 5.7 (SD=1.7) at the baseline session to 6.7 (SD=1.9) at 4 weeks (Pillai's trace=.21,  $F(2, 42)=5.59, p=.007, \eta_p^2=.21$ ), and this change with time interacted with condition (Pillai's trace=.19,  $F(2, 42)=4.86, p=.013, \eta_p^2=.19$ ). As shown in Figure 2, MTF increased following the meeting in which the FIT intervention was delivered: comparing the weeks before and after FIT delivery showed a main effect of time ( $F(1,43)=12.20, p=.001, \eta_p^2=.22$ ), and as expected, there was no interaction of this effect with condition ( $F < 1$ ). Analysing each group separately, MTF increased marginally between baseline and 2 weeks for the Immediate group ( $F(1,23)=3.99, p=.058, \eta_p^2=.15$ ), and did not change between 2 and 4 weeks ( $F < 1$ ); it did not change between baseline and 2 weeks for the Delayed group ( $F < 1$ ), but then rose between 2 and 4 weeks ( $F(1,20)=11.8, p=.003, \eta_p^2=.37$ ).

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Insert Figure 2 about here.

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Moreover, bivariate correlations showed that the reduction in snack consumption was associated with an increased frequency of thoughts about cutting down on snacks; from baseline to 2 weeks  $r(45)=.29, p=.027$ ; and from 2 to 4 weeks  $r(45)=.32, p=.017$ .

### *Weight change*

Although we had not predicted changes in weight over the short timescale of this experiment, we had measured participants' weight at each session as they had been recruited to a 'weight loss' experiment. Overall, our participants' weight

reduced from a mean of 74.8kg at baseline to 74.1kg at 4 weeks (mean change= 0.71kg, 95% CI 0.22 – 1.21,  $t(44)=2.90$ ,  $p=.006$ ). A 2 (condition) x 3 (time) MANOVA confirmed this reduction over time (Pillai's trace=.16,  $F(2,42)= 4.05$ ,  $p=.025$ ,  $\eta_p^2=.16$ ) but showed no interaction between time and condition ( $F < 1$ ). Overall weight loss from baseline to week 4 was not correlated with baseline BMI ( $r(45)= -.04$ ,  $p=.82$ ) or baseline weight ( $r(45)= .06$ ,  $p=.70$ ), but weight loss in the 2 weeks following FIT, as a proportion of weight pre-FIT, correlated with increase in MTF-D scores ( $r(45)=.27$ ,  $p=.039$  one tailed).

### Discussion

In this experiment we have shown that a brief, imagery-based FIT intervention lasting less than an hour is followed by an increase in the frequency of motivational thoughts about cutting down on snacks between meals, a decrease in the number of snacking occasions, and a reduction in overall consumption of snacks. The increase in motivational thought frequency, and the decrease in snacking occurred over the 2 weeks immediately following the FIT session, and for the group who received it at the baseline meeting, persisted for 4 weeks. This single session plus brief booster call was better than the brief advice, information leaflet, and general motivating effect of taking part in a study involving self-reports of snacking.

Participants lost a modest amount of weight (around 0.7kg) over the 4-week study period. As in any weight loss experiment, this loss might be expected due to a Hawthorne effect, as participants become more aware of their eating and weight (e.g., Merikle & Skanes, 1992). However, as we only targeted one aspect of participants' eating habits, i.e., snacking, and not their diet as a whole, there was a risk that they would compensate for reductions in snacking with increases in calorie consumption during meals. Fortunately this does not seem to have been the case.

Consistent with the hypothesis that changes in motivation engendered by FIT contributed to the weight loss, the amount of weight lost by participants in the 2 weeks after FIT was positively correlated with their reported increase in desire to snack less. As this study was designed to test the impact of FIT on the specific dietary behaviour of snacking, further research is needed to test the efficacy of FIT for encouraging healthy eating habits in general and supporting weight loss in those who are overweight, as well as assessing if weight loss is mediated by the specific motivational processes targeted by FIT. FIT is designed as a general motivational intervention and we predict that it will be as effective, if not more so, when focused on positive, highly imageable changes to diet, such as increasing fruit and vegetable consumption, as when focused on cutting foods out of the diet.

EI Theory holds that the FIT intervention works by providing the individual with personally salient, vivid visual images of their desire to achieve a goal that will be triggered by any episodes of temptation inconsistent with that goal. In the context of weight loss, the sight, smell or contextual cues associated with a snack can easily remind people of the immediate sensory pleasure that they will obtain from giving into the temptation, and the vividness of these imagined delights can far outweigh the abstract intention to abstain. FIT strengthens the vividness and salience of the longer-term intention and links it to the temptations themselves, so that the individual is reminded of their goal every time they think of snacking. The correlations found here between increases in an individual's motivational thought frequency, their reduction in snacking, and weight loss, support this argument.

Positive results from FIT are also consistent with findings that episodic future thinking (EFT) can reduce impulsivity and energy intake in women with overweight or obesity. Daniel et al. (2013) asked participants to generate mental imagery about

personal positive future events, which were not necessarily linked to achieving the abstinence goal, and measured effects immediately afterwards. FIT differs by specifically focusing imagery on proximal, positive outcomes of working towards a goal and rehearsing that imagery, so that tempting cues elicit imagery related to the abstinence goal rather than (or as well as) indulgence, thus ensuring that the intervention is self-perpetuating and lasts beyond the experimental session.

However, we cannot conclude that the changes in snacking and weight were specifically caused by FIT, as its sessions included elements such as goal setting shared with other treatments, and were followed by a booster phone call a week later, which might have served as an additional cue to avoid snacking. In particular, FIT is delivered in the style of Motivational Interviewing (MI), which has itself been shown to enhance weight loss (Armstrong et al. 2011). The purpose of this study was to test if FIT supported behaviour change relative to brief advice and information about healthy eating. Further work is needed to compare FIT with an MI condition lacking an emphasis upon imagery of personally salient goal-related episodes, and to test whether the effects of FIT are mediated by the enhancement of goal imagery, as predicted by EI theory. It would also be important to compare the benefits of personally relevant and generic motivational imagery, to evaluate the importance of individual tailoring. While FIT appears efficacious in the short term, longer and larger-scale studies are now required to evaluate its effectiveness in improving dietary behaviours and helping individuals maintain weight loss over time. We anticipate that the focus on training functional imagery will be particularly advantageous for sustaining motivation as it equips clients with the skills to set and rehearse sub-goals about challenging situations that occur over time.

The absence of a correlation between BMI and weight loss encourages the conclusion that FIT may work across the weight range and can be used to enhance healthy eating in the general population. However, it would be valuable to evaluate the efficacy of FIT for participants with obesity, specifically recruiting a sample with BMI above 30.

FIT is an example of basic theoretical work, supported by controlled experimental research on analogue populations, finding application in an important practical context. The core argument of EI Theory (Kavanagh et al, 2005), that desire has common cognitive foundations across everyday and pathological cravings, and that imagery plays a central role in the origin and maintenance of episodes of desire, has now been supported in a wide range of studies (May, Kavanagh & Andrade, 2015). In this paper, we have applied FIT to an abstinence goal, namely reducing snacking. In related work, we are applying FIT to another abstinence goal, to help cut down on drinking, but also to encourage the uptake of healthy behaviours, such as physical activity (Lennox, Andrade, Kavanagh & May, under review). Understanding the role that mental imagery plays in motivation, both in clinical (May, Andrade & Kavanagh, 2015) and everyday situations (Skorka-Brown, Andrade, Whalley & May, 2015), can inform the development of more cost-effective preventive interventions and treatments for a wide range of behavioural problems.

### References

- Andrade, J., May, J., & Kavanagh, D. K. (2012). Sensory imagery in craving: From cognitive psychology to new treatments for addiction. *Journal of Experimental Psychopathology*, 3.
- Armstrong, M. J., Mottershead, T. A., Ronksley, P. E., Sigal, R. J., Campbell, T. S., & Hemmelgarn, B. R. (2011). Motivational interviewing to improve weight loss in

- overweight and/or obese patients: a systematic review and meta-analysis of randomized controlled trials. *Obesity reviews*, 12(9), 709-723.
- Basdevant, A., Craplet, C., & Guy-Grand, B. (1993). Snacking patterns in obese French women. *Appetite*, 21(1), 17-23.
- Berteus Forslund, H., Torgerson, J. S., Sjostrom, L., et al. (2005). Snacking frequency in relation to energy intake and food choices in obese men and women compared to a reference population. *International Journal of Obesity and Related Metabolic Disorders*, 29, 711–719
- Booth, D.A. (1988). Mechanisms from models – actual effects from real life: the zero-calorie drink-break option. *Appetite*, 11(Suppl 1), 94–102
- Booth, H.P., Prevost, A.T. & Gulliford, M.C. (2015) Access to weight reduction interventions for overweight and obese patients in UK primary care: population-based cohort study. *BMJ Open*, 5, e006642
- Brown, R. A., Burgess, E. S., Sales, S. D., Whiteley, J. A., Evans, D. M., & Miller, I. W. (1998). Reliability and validity of a smoking timeline follow-back interview. *Psychology of Addictive Behaviors*, 12(2), 101.
- Chao, A., Grilo, C.M., White, M.A., Sinha, R. (2014) Food cravings, food intake, and weight status in a community-based sample. *Eating Behaviour*, 15, 478–82.
- Counterweight Project Team. (2004) Current approaches to obesity management in UK primary care: the Counterweight programme. *Journal of Human Nutrition and Dietetics*, 17, 183-190.
- Craig, P., Dieppe, P., Macintyre, S., Michie, S., Nazareth, I., Pettigrew, M. (2008) Developing and evaluating complex interventions: the new Medical Research Council guidance. *British Medical Journal*, 337, a1655.
- Daniel, T. O., Stanton, C. M., & Epstein, L. H. (2013). The future is now: comparing the effect of episodic future thinking on impulsivity in lean and obese individuals. *Appetite*, 71, 120-125.
- Drummond, S., Crombie, N., & Kirk, T. (1996). A critique of the effects of snacking on body weight status. *European Journal of Clinical Nutrition*, 50(12), 779-783.

- Gilhooly, C.H., Das, S.K., Golden, J.K., McCrory, M.A., Dallal, G.E., Saltzman, E., et al. (2007) Food cravings and energy regulation: the characteristics of craved foods and their relationship with eating behaviors and weight change during 6 months of dietary energy restriction. *International Journal of Obesity*, 31, 1849–58.
- Hampel, J. S., Heaton, C. L. B., & Taylor, C. A. (2003). Snacking patterns influence energy and nutrient intakes but not body mass index. *Journal of Human Nutrition and Dietetics*, 16(1), 3-11.
- Holmes, E., & Mathews, A. (2005). Mental Imagery and Emotion- A Special Relationship? *Emotion*, 5(4), 489–497.
- Hussey MA, Hughes JP. (2007). Design and analysis of stepped wedge cluster randomized trials *Contemporary Clinical Trials*, 28, 182-191
- Jahns, L., Siega-Riz, A. M., & Popkin, B. M. (2001). The increasing prevalence of snacking among US children from 1977 to 1996. *The Journal of Pediatrics*, 138, 493-498.
- Kavanagh, D. J., Andrade, J., & May, J. (2005). Imaginary relish and exquisite torture: the elaborated intrusion theory of desire. *Psychological Review*, 112(2), 446.
- Kavanagh, D. J., Andrade, J., May, J., & Connor, J. P. (2014). Motivational interventions may have greater sustained impact if they trained imagery-based self-management. *Addiction*, 109(7), 1062-1063.
- Kavanagh, D. J., Connolly, J., May, J., Andrade, J., Godfrey, S., Carroll, A., Taylor, K., & Connor, J. (under review) The Goal Motivation Scale for Physical Activity (GMS-PA): A New Measure of Motivational State
- Kenny, T., & Sambrook, M. (2014). *Healthy Eating*. Retrieved from [www.patient.co.uk/health/Healthy-Eating.htm](http://www.patient.co.uk/health/Healthy-Eating.htm)
- Kim, H., Schnall, S., Yi, D. J., & White, M. P. (2013). Social distance decreases responders' sensitivity to fairness in the ultimatum game. *Judgment and Decision Making*, 8(5), 632-638.

- Knäuper, B., Pillay, R., Lacaille, J., McCollam, A., & Kelso, E. (2011). Replacing craving imagery with alternative pleasant imagery reduces craving intensity. *Appetite, 57*(1), 173-178.
- Knäuper, B., Roseman, M., Johnson, P. J., & Krantz, L. H. (2009). Using mental imagery to enhance the effectiveness of implementation intentions. *Current Psychology, 28*(3), 181-186.
- Lafay, L., Thomas, F., Mennen, L., Charles, M. A., Eschwege, E., & Borys, J. M. (2001). Gender differences in the relation between food cravings and mood in an adult community: Results from the Fleurbaix Laventie Ville Sante study. *International Journal of Eating Disorders, 29*(2), 195-204.
- Lennox, E., Andrade, J., Kavanagh, D. J. & May, J. (under review) Do you come here often? Using mental imagery to increase motivation and physical activity.
- Lewis-Esquerre, J. M., Colby, S. M., Tevyaw, T. O. L., Eaton, C. A., Kahler, C. W., & Monti, P. M. (2005). Validation of the timeline follow-back in the assessment of adolescent smoking. *Drug and alcohol dependence, 79*(1), 33-43.
- May, J., Andrade, J., & Kavanagh, D.J. (2015). An imagery-based road map to tackle maladaptive motivational imagery in clinical disorders. *Frontiers in Psychiatry, 6*, art 14.
- May, J., Andrade, J., Kavanagh, D.K., Feeney, G.F.X., Gullo, M.J., Statham, D., Skorka-Brown, J., Cassimatis, M., Young, R.McD., Connor, J.P. (2014) The Craving Experience Questionnaire: A Brief, Theory-Based Measure of Consummatory Desire and Craving. *Addiction, 109*, 728-735.
- May, J., Andrade, J., Kavanagh, D. J., & Hetherington, M. (2012). Elaborated Intrusion theory: A cognitive-emotional theory of food craving. *Current Obesity Reports, 1*(2), 114-121.
- May, J., Andrade, J., Panabokke, N., & Kavanagh, D. (2004). Images of desire: Cognitive models of craving. *Memory, 12*(4), 447-461.
- May, J., Kavanagh, D. J., & Andrade, J. (2015). The Elaborated Intrusion Theory of Desire: A 10-year retrospective and implications for addiction treatments. *Addictive Behaviors, 44*, 29-34.

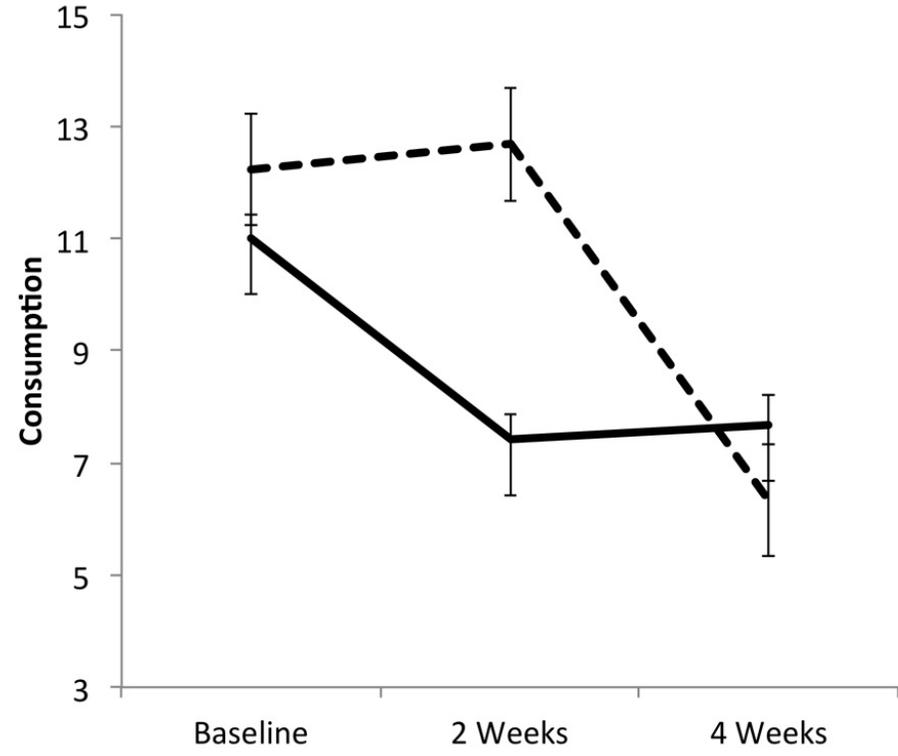
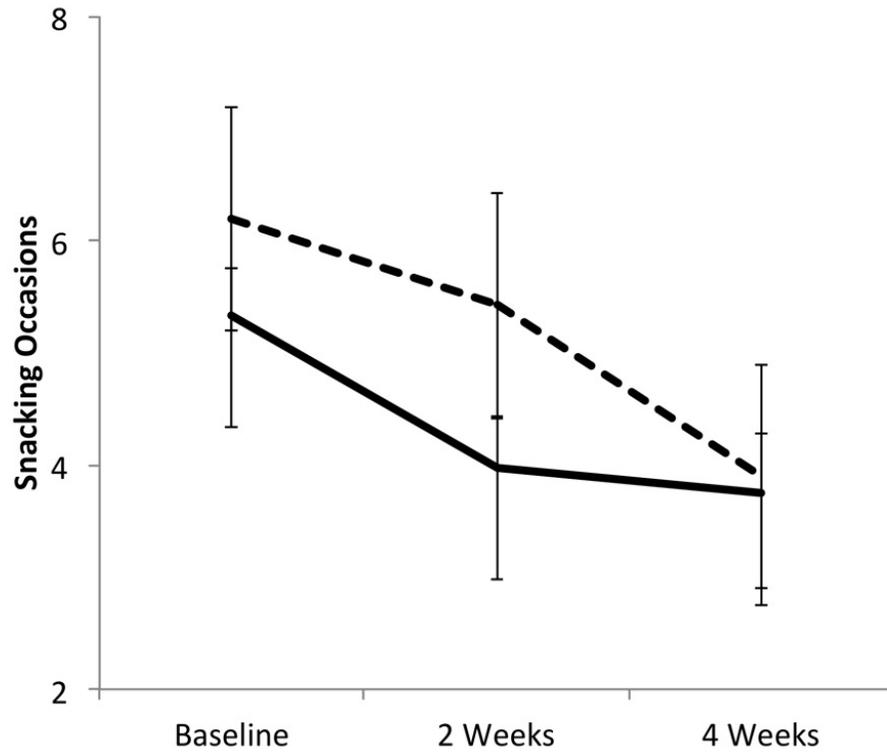
- Merikle, P.M. & Skanes, H.E. (1992) Subliminal self-help audiotapes- a search for placebo effects. *Journal of Applied Psychology*, 77, 772-776
- Miller, W. R., & Rollnick, S. (2012). *Motivational interviewing: Helping people change*. Guilford press.
- Nicklas, T. A., O'Neil, C. E., & Fulgoni III, V. L. (2014). Snacking patterns, diet quality, and cardiovascular risk factors in adults. *BMC Public Health*, 14(1), 388.
- OECD. (2014). Overweight and obesity. In *OECD Factbook 2014: Economic, Environmental and Social Statistics*, OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/factbook-2014-102-en>. Accessed 5th February 2016.
- Pedersen, E. R., Grow, J., Duncan, S., Neighbors, C., & Larimer, M. E. (2012). Concurrent Validity of an Online Version of the Timeline Followback Assessment. *Psychology Of Addictive Behaviors*, 26, 672-677.
- Robinson, N., Kavanagh, D. J., Connor, J., May, J. & Andrade, J. (under review) Assessment of Motivation to Control Alcohol Use: The Goal Motivation Scales for Alcohol.
- Skorka-Brown, J., Andrade, J., Whalley, B. & May, J. (2015) Playing Tetris decreases drug and other cravings in real world settings. *Addictive Behaviors*. 51, 165-170
- Sobell, L. C., & Sobell, M. B. (1992). Timeline follow-back. In R. Z. Litten & J. P. Allen JP, (Eds) *Measuring alcohol consumption: psychosocial and biochemical methods*. Totowa, NJ: Humana Press, pp. 41–72.
- Statham, D.J., Connor, J.P., Kavanagh, D.J., Feeney G.F.X., Young, R.Mc.D., May, J. & Andrade, J. (2011) Measuring alcohol craving- development of the Alcohol Craving Experience questionnaire. *Addiction*, 106(7), 1230-1238
- Trope, Y., & Liberman, N. (2010). Construal-level theory of psychological distance. *Psychological review*, 117(2), 440.
- VanWormer, J. J., & Boucher, J. L. (2004). Motivational interviewing and diet modification: a review of the evidence. *The Diabetes Educator*, 30(3), 404-419.

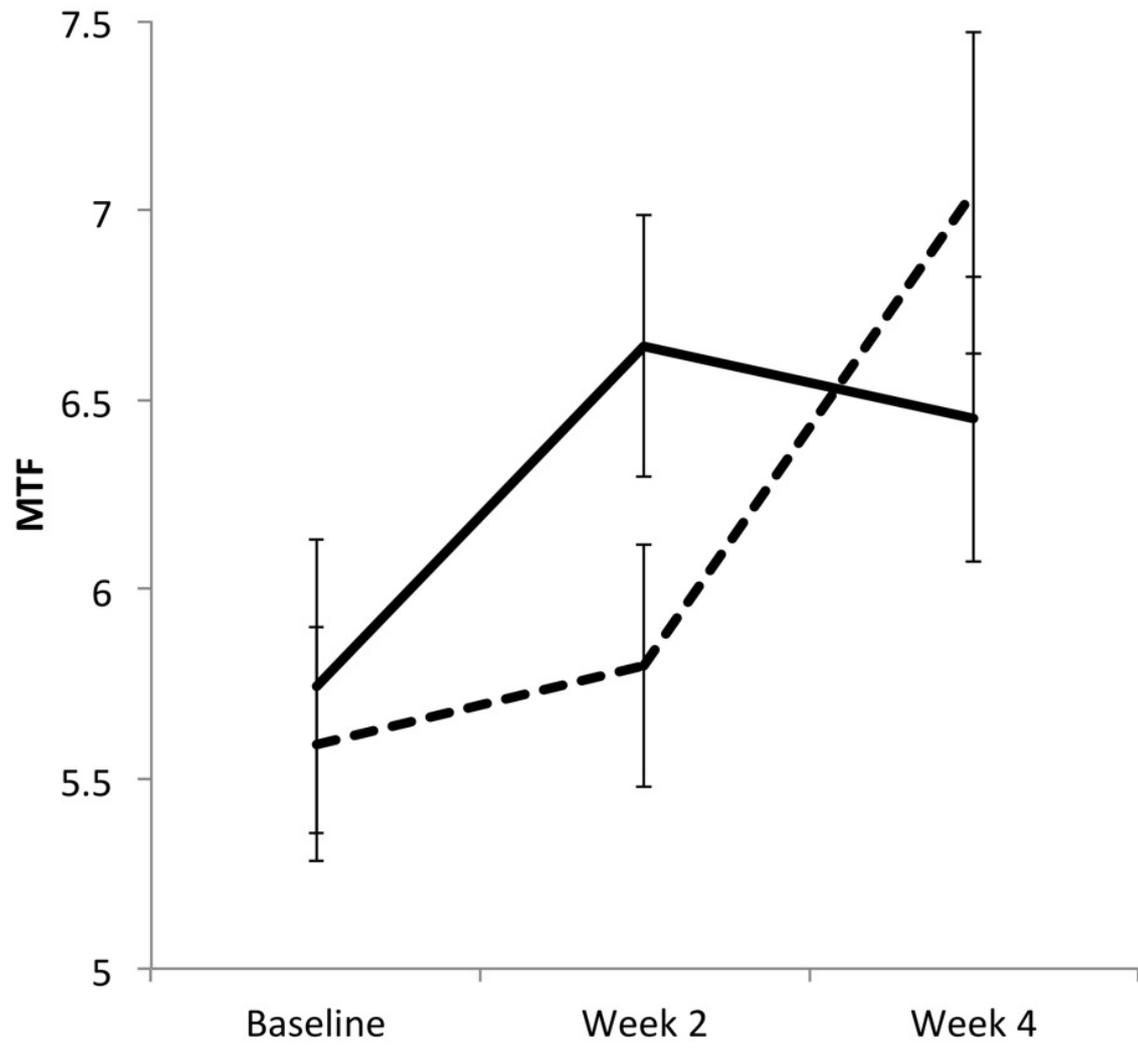
World Health Organization (2015). *Fact sheet No.311: Obesity and overweight*.  
<http://www.who.int/mediacentre/factsheets/fs311/en/> Accessed 5<sup>th</sup> February  
2016.

Figure Captions:

Figure 1. Snacking occasions and consumption dropped following delivery of FIT for both the immediate group (solid line) and for the delayed group (dashed line).

Figure 2. Motivational Thought Frequency (MTF) scores rose following delivery of FIT for both the immediate condition (solid line) and delayed condition (dashed line).





## Supplementary materials

### Functional Imagery Training Manual for snacking reduction

#### Introduction

Thanks for coming in today. I understand that you're wanting to lose weight.

Keeping yourself fit and trim of course involves a range of healthy lifestyle actions, but today I suggest we focus just on high-calorie desserts or snacks and sugary or alcoholic drinks.

Is that OK?

---

#### Initial brief review of downsides

Can you tell me about any desserts, snacks, or sugary or alcoholic drinks you have?

---

Is that/are those [insert what is having] producing any issues for you?

---

[After each issue]:

Does that concern/worry/bother you? [Vary wording]  
Why?

---

Is there anything else you don't like so much about the [insert names] you are having?

---

[if they have not answered about all the things they have]:

What about [the omitted food or drink]? Are there any things you don't like so much about having that?...Anything else?

---

Let's turn this around. If you cut down on [list things they have] what improvements might you notice after, say, a year?

---

Would you notice any changes even in the first week?

[If no:] Would any improvements be likely to happen in, say, a month?

[Early positive changes are particularly useful in maintaining initial changes, if we can find any]

---

## Summary

So you said that *[insert the thing they are having]* is *[insert negative effects]*. Is that right?

---

How do you feel about all of that?

---

## Imagery and emotion

As I said at the start, we are looking at using imagery to help people work out what they want to do.

Imagery can be really powerful. Can I show you how you can use it?

---

*[Give a brief version of lemon exercise]*

---

So, you can see that sensory imagery is closely linked to how we feel.

Can we go back to the things you mentioned about snacks and drinks?

---

In your head, imagine that you have been having fewer *[insert names of sugary snacks and drinks and alcohol]* for a whole year.

You notice that *[insert positive change mentioned earlier]*.

Imagine a particular occasion when you would notice that. Have you got one?

*[Let them briefly describe the situation--give help if they are stuck]*

---

Let the event roll out—like a TV ad, where you are acting in it...

Don't tell me just yet what you're experiencing...just imagine it as vividly as you can...

Notice what you see...where you are... who is with you...

What is going on around you...what you are doing...

Notice what you hear...and feel in your body...

Notice how real that is...

And how you feel, emotionally...

If your mind wonders, just come back to the scene and play out the story...

---

How vivid was the image, on a scale of 0-10, where 0 is no image at all, and 10 is extremely vivid, as if it were actually happening?

*[Record on session rating scale, and listen to any issues the person had with constructing the image. If they had trouble, say something like:]*

It can sometimes be hard at first to use imagery—it gets more vivid with practice. Let's see if it had any impact at all.

*[ALL:]*

What part of that scenario did you enjoy the most?

What was so good about that?

So, after imagining what it would be like to change what you are *[eating/drinking]*, what would you like to do?

## Self-efficacy

How confident are you that you could do that for at least a week?—say, on a scale from 0—definitely can't do it, to 100%—sure I can?

*[Record the rating]*

*[If ≥ 40:]*

OK, so you're pretty confident already.

*[If < 40:]*

That's OK—people are often feeling a bit unsure at first.

*[ALL:]*

Let's see what happens when you think about that some more.

Have you had past successes with cutting down on snacks, desserts, sugary drinks or alcohol?

*[If no:]*

What about cutting down on something else?

*[If no:]*

Studying? Practising the piano, or doing exercise?

*[ALL:]*

Recreate a particular occasion when that happened....

Imagine where you are...Who you are with...What is going on around you...

What you are doing...

Play it out like a TV ad, where you are an actor...

Let the event roll out, as if it is happening now...

Once again, noticing what you see...

What you hear...and feel in your body...

Noticing how real it is...

And how you feel, emotionally...

\_\_\_\_\_

How was that?

\_\_\_\_\_

Did you notice what you did, to stay in control?

\_\_\_\_\_

Could you do that/those things now?

\_\_\_\_\_

What else could you do, to stay in control?

\_\_\_\_\_

Is there anyone who could help?

\_\_\_\_\_

What would you like them to do?

\_\_\_\_\_

What could you do, to make sure they did that?

\_\_\_\_\_

OK, let's try imagining that happening over the next few days.

If you were staying in control of [insert snacks/drinks] over the next week, how would you get started?

Try briefly imagining yourself doing that over the next few days....

\_\_\_\_\_

Is there likely to be a difficult situation for staying in control of *[list their snacks/drinks]* over the next week?

Tell me about that.

*[Help them select a situation if necessary]*

\_\_\_\_\_

Let's try playing that event out, as a TV ad...

Let the event roll out, as if it is happening now...

Imagine what you are doing, to stay in control....

Make it as real as you can...

Now, imagine how you feel, when you are successful...

\_\_\_\_\_

How was that?

*[Help them address any problems with imagining that scenario—if necessary, redo it].*

\_\_\_\_\_

How confident are you now, that you can *[insert goal]* for at least a week? Use that same scale, from 0—definitely can't do it, to 100%—sure I can?

*[Record the rating]*

*[If > than earlier:]*

That's great! Just thinking about a time you succeeded in the past, and how you did it, can increase your confidence.

*[If > around 60:]*

Wow—that's great. Sounds like you're pretty confident.

*[If around 40-59:]*

That's fine for getting started. You don't have to be 100% confident—you just need enough to take the first step.

*[If < around 40:]*

Confidence often gets stronger once people see what they can do.

Is that enough for you to at least take a first step?

*[If no:]*

I wonder what you could do, so you could become a bit more confident?

*[Then use imagery to make a plan about doing that]*

---

## Plan for the next few days

So, what do you plan to do now, about your *[insert snacking/drinks]*?

*[if needed, prompt with:]*

How will you get started with that?

What will you do, to stay in control?

---

Sounds like you've thought that through.

---

## Practice using imagery cues

Was using imagery today helpful?

*[If yes:]* How did it help?

Do you think it would help if you used imagery at home?

---

If you are using it at home, it doesn't have to be for long. And you can do it while you are doing other things.

In fact, it will remind you to practise, if you get in the habit of practising at the same time as a very frequent behaviour, like washing your hands. Would that be a good one to use?

*[Elicit an alternative if the person prefers]*

Can we practise doing that now?

---

*[Take them to a sink or other relevant location where they can practise]*

Imagine a time in the next hour or two where you want to stay in control of *[insert the snack/drink]*.

Roll that event out in your mind, imagining how you will stay in control, and how good it will feel to succeed. Make it as vivid as you can.

*[Keep the practice to around 10-15 seconds, so they it coincides with the normal duration of handwashing]*

---

Can you see that you can do that easily each time you wash your hands?

If there is a hard situation coming up, you might also want to set a reminder on your mobile phone, to practise the imagery.

Is there a time tomorrow, where you'd like to have a reminder to practise the imagery?

*[If yes, get them to set that reminder—if it is a recurring issue, ask them to consider having a recurring reminder on their phone for the next few days].*

---

Using that imagery will help keep you on track. It will also help if you create new images of your motivations, plan, and successes as you go along, to help keep you going when things get tough.

Would it help, to have some photos on your phone, that can trigger the imagery?

*[if yes:]* Maybe you could try taking some photos that would do that.

For example, what photo could remind you to practise imagining *[insert a likely positive outcome over the next few days]* occurring?

What photo could remind you to *[insert their preferred control strategy]*?

You could look at those images whenever you want to use the imagery.

---

*[Give the person the weight loss leaflets]*

---

### **Negotiate next appointment**

I'll call you over the next few days to see how you are going.

When would be a good time to call you next *[insert day in a week's time]*?

Thank you for working so hard with me in this session.

All the best with your attempt over the next week. I'll talk to you on *[insert day in a week's time]* at *[insert time]*.

## Appendix

### *The spirit of motivational interviewing*

- It emphasises collaboration, autonomy, choice and empathy, while having a clear, negotiated agenda.
- It encourages them to think about and talk about their own reasons for change and ideas for how change could or should happen, with the goal of them considering change as a positive, feasible option.
- It elicits their emotional response throughout and attempts to deepen their understanding of their emotions about snacking.
- It does not focus on information-giving. Provide information only to reinforce their statements, answer questions, or (gently) correct misinformation.

It does not attempt to convince the client to make any particular change and respects the client's autonomy. 'Roll with resistance'. See what they want to do, and agree to support them.

### **Imagery based review of motivation**

Functional Imagery training uses the spirit of motivational interviewing, but is fundamentally different from it.

- Every step is conducted via imagery
- The primary focus is not on generating initial commitment: it is on teaching a skill for use in the natural environment--laying the groundwork for rehearsal when they are deciding whether to snack or not.

FOR ALL IMAGERY EXERCISES, make sure the client does the imagery exercise in their mind, and then describes it afterwards.

Give them sufficient time to imagine each statement before moving on to the next one.

## How vivid was the image?

0 1 2 3 4 5 6 7 8 9 10  
No image Extremely vivid

---



## Therapist Record Sheet – (not for client)

---

Reasons for change	Hypothetical change	Past successes
		Initial self-efficacy rating: ___/100
		Second self-efficacy rating: ___/100 <hr/>

