**The best laid plans: planning skill determines the effectiveness of action plans and implementation intentions.**

AUTHOR DETAILS REMOVED FOR REVIEW

**Abstract (150)**

Background: Theories of action control emphasise the importance of planning, but plans are not universally beneficial.

Purpose: The present study investigates whether the effectiveness of plans depends upon the skill of the planner.

Methods: Study 1 prospectively predicted changes in unhealthy snacking behaviour over one week from intentions, action planning and performance on a standardised cognitive test of planning skill (n=72). Study 2 experimentally randomised skilled and poor planners to receive (or not) a planning intervention before completing an online food diary (n=144)

Results: Spontaneously generated action plans about snacking explained significantly more variance in subsequent snacking if produced by a skilled rather than a poor planner. The planning intervention (implementation intention) significantly improved goal attainment but only in poor planners.

Conclusions: Plans are only as good as the people who make them. Poor planners’ plans do not help achieve goals. Planning interventions can compensate for a lack of planning skill.

**4-6 keywords**

Planning; plans; implementation intentions; action plans

**Introduction**

Health behaviour theories such as the Theory of Planned Behaviour[1] identify intentions as the most important determinant of action. However, individuals frequently form intentions about lifestyle behaviours (e.g. eating more healthily), and subsequently fail to act on them[2], This so-called ‘intention-behaviour gap’ highlights the need to distinguish between the motivational phase of action control (where intentions are formed on the basis of beliefs) and the volitional phase (where intended actions are planned, initiated, and maintained)[3]. During the volitional phase, planning plays a vital role.

Although ‘plans’ in common parlance are often used synonymously with ‘intentions’ (i.e. “I plan / intend to do X”), planning in its true sense is a purely volitional construct that allows individuals to generate a mental representation of the necessary steps involved in achieving a specific intention. ‘Action planning’[4], where the ‘when’, ‘where’ and ‘how’ of an intended action are specified in advance, can increase the likelihood of goal attainment by linking intended behaviours to appropriate situational or internal cues. People who spontaneously hold action plans or who are instructed to generate them (by forming an if-then plan or ‘implementation intention’) are more likely to achieve their intentions[5] and beneficial effects of action planning have been demonstrated across a wide range of conceptually distinct health behaviours including: tetanus inoculation[4], participation in physical activity[5]; consumption of a healthy diet[6], breast examination[7] and alcohol consumption[8]. However, despite the general benefits of action planning for behaviour change, action plans are not universally effective with several studies failing to find any effect of either spontaneously generated or instructed action planning[9,10,11,12,13].

As plans are not universally beneficial, plan effectiveness must be moderated by other, as yet unidentified, factors[14], such as plan quality. It seems likely that good quality plans will be more useful than others, but plan quality is difficult to quantify. One way to approach this problem is to move away from the plans themselves and to look instead at the skill of the planner. Planning, as a construct in cognitive psychology is operationalised as a generic cognitive skill used to organise behaviour so that a specified goal can be accomplished through a series of intermediate steps, the mental representation of this series of steps constituting the ‘plan’[15].

 Inter-individual differences in planning skill might determine how helpful individual plans are for behaviour change. The ability to form and implement plans is a key component of ‘executive functioning’[16], and meaningful individual differences in the planning abilities of healthy adults can be reliably detected[16,17,18] through the use of standard cognitive and neuropsychological tasks that quantitatively assess the efficiency with which plans are generated and implemented. The advantage of using standardised cognitive tasks to assess planning skill is that each task has a predefined optimal solution so inferences about the quality and efficiency of planning can be made through analysis of completion speed and accuracy. If high quality plans are more effective than others and people vary in their ability to generate high quality plans, then (a) the action plans of skilled planners should be more beneficial for behaviour change than the action plans of poor planners, and (b) it should be possible to compensate for naturally poor planning ability by providing individuals with high quality plans.

The present paper reports the results of a predictive/observational and an experimental intervention study investigating these two hypotheses in the context of high calorie snacking behaviour and dietary self-monitoring.

**Study 1: Predictive**

 **Methods**

Study 1 aimed to determine whether plans spontaneously formed by skilled planners facilitate behaviour change more than plans formed by poor planners.

Participants & Design: Participants (n=72, n=60 female, adult University students) with a mean age of 19.8 years (SD=3.8) took part in a within-participants prospective study predicting changes in unhealthy snacking behaviour from intentions, action planning and planning skill measured one week previously. The sample size was determined for a multiple regression analysis with 3 predictor variables, alpha=0.05, power =0.80, and a medium (0.15) effect of planning skill on snacking behaviour[19]. The study was approved by the University of Aberdeen Psychology Ethics Committee (PEC1702091198). There were no formal inclusion or exclusion criteria. Participants received course credit for participation.

Measures

 ‘Unhealthy snacks’ were defined as ‘non-core’ foods, that is, foods that are not part of any of the main food groups recommended for daily consumption, i.e. crisps, chocolate, sweets, cakes, biscuits, pies, pastries[20]. Participants were instructed to make their responses about ‘snacks’ based solely on the foods listed.

 *Intentions to limit snacking* were assessed with 3 items (α =.80) answered on a 4-point Likert scale from Strongly Agree to Strongly Disagree; “Over the **next** week, I intend to……..” (1) have no more than 1 snack per day, (2) avoid snacks, (3) reduce the number of snacks I eat.

*Action Planning* was measured with 4 items (α=.68) answered yes/no; “I have made a detailed plan about…….” (1) when I am going to avoid snacks, (2) what kinds of snacks I am going to avoid, (3) what I will eat instead of snacks I am trying to avoid, (4) how often I will try to avoid eating snacks. ‘Yes’ responses were scored as 1 and scores were summed (0-4), with higher scores indicating more action planning.

 *Planning skill* was measured using the ‘Zoo-Map’ task from the Behavioural Assessment of the Dysexecutive Syndrome test battery[21], a task with good ecological and construct validity[22]. Participants use a map of a zoo to plan the most efficient way to visit multiple animals in different locations while adhering to several rules (e.g. only using some paths once). Plan quality is indexed through speed and route efficiency, with faster and more efficient performance being indicative of skilled planning. Variation in non-planning processes (i.e. motor speed/reading comprehension) is captured in a control trial where participants follow instructions to map out an instructed route. The difference in time between the two trials (planning vs. control) was used as the measure of planning skill.

 *Snacking behaviour* was measured one week later with 3 items (α =.67) answered on a 4-point Likert scale from Strongly Agree to Strongly Disagree; “Over the **past** week I...” (1) had no more than 1 snack per day, (2) avoided snacks, (3) reduced the number of snacks I ate.

**Analysis**

Data were entered into SPSS version 19 and analysed using hierarchical regression. The dependent variable (snacking behaviour) was predicted from planning skill (Zoo Map score), action plans and intentions to limit snacking. As the hypothesis concerns an interaction, and for ease of interpretation, all relevant variables were centred prior to entry into the model[23]. Age and gender were entered in block 1, planning skill, action planning and intentions to limit snacking in block 2, and finally to test our hypothesis, the interaction between planning skill and action planning was entered in block 3.

**Results**

Participants reported moderate levels of intention to limit snacking (M=2.2; SD=.73; on a scale from 1-4); and action planning (M=1.7; SD=1.36; on a scale from 0-4), and snack consumption one week later (M=2.6; SD=.68, on a scale from 1-4). Planning skill varied considerably between participants (M=59.6 seconds; SD=47.82). Correlations between the variables can be seen in Table 1.

The multiple regression model explained 20% of the variance in snacking over 1 week (Table 2). In the final model, both planning skill (Beta= .31, p=.01) and intentions to limit snacking (Beta= .35, p=.009) explained a significant amount of the variance in snacking. Action planning did not (Beta= .05, p= .68). Importantly for the present hypothesis, there was a significant interaction between planning skill and action planning (Beta= .25, p=.03) reflecting the fact that action plans about reducing snacking only predict reduced snacking behaviour if generated by skilled planners (Figure 1). As the multiple items used to measure snacking frequency referred to slightly different behaviours and perhaps as a result may have displayed relatively low internal consistency (α = .67), the analyses were re-run using single item measures of intention and behaviour (“I intend to have / had….no more than one snack per day”). The pattern of results remained the same with planning skill (Beta= .23, p=.03) and intention to limit snacking (Beta= .43, p<.01) explaining a significant amount of the variance while action planning did not (Beta= .13, p=.27). The interaction between planning skill and action planning reduced somewhat but maintained borderline significance (Beta= .21, p=.05).

*{insert Table 1, Table 2 & Figure 1 about here}*

**Study 2: Intervention**

 **Methods**

The results of Study 1 suggest that poor planners are less able to generate effective plans. Study 2 tested whether planning interventions can compensate for low levels of planning skill. It was hypothesised that without help, skilled planners would be more likely to achieve a behavioural goal, but that poor planners would benefit more from a planning intervention.

Participants & Design: 144 participants (116 female, adult University students) with a mean age of 20.9 years (SD=5.9) took part in a randomised between-participants experimental study comparing the beneficial effects of a planning intervention on the subsequent behaviour (successful completion of an intended online food diary) of skilled and poor planners. Sample size was well above the minimum level recommended to ensure adequate power (0.8) in a 2x2x2 loglinear analysis (min= no.cells x10=80) [24]The study was approved by the University of Aberdeen Psychology Ethics Committee. There were no formal inclusion or exclusion criteria. Participants received course credit for participation.

 Measures

*Planning Skill:* Since the study design required identification of ‘good’ and ‘poor’ planners, a planning task with norms based on a large sample was required to validate the results of a median split. Therefore, planning skill was measured with the Tower Task from the Delis-Kaplan Executive Function System (D-KEFS)[25]. This task has a much larger normative sample than the Zoo Map task used in Study 1. Both tasks estimate planning skill from speed and accuracy of performance and are commonly used in the cognitive literature to assess planning[26]. Participants are asked to move 5 different sized wooden discs arranged in a ‘start’ position into a predefined ‘goal’ position, using as few moves as possible and without placing larger discs on top of smaller discs. There are 9 trials ranging in difficulty from 1 to 26 moves and the task is scored out of 30 according to the number of moves, completion time and rule violations. Low scores indicate poor planning.

*Behavioural Outcome:* The behavioural outcome was successful completion of this diary within the specified timeframe (and not snack intake itself). Participants were instructed to monitor their ‘non-core’ snack intake (see Study 1 for details) and complete an online food diary detailing intake within a specified 24 hour period. The website automatically recorded time of completion, and participants were told that failure to complete within the specified period would result in loss of course credit.

**Randomisation and Planning Intervention**

Participants were randomly allocated (using shuffled, sealed envelopes containing ‘intervention’ and ‘control’ instructions) to receive a planning intervention or not. Participants in both conditions completed and signed a form stating: “I intend to log onto the website within 24 hours of completion of the snack monitoring task - AGREE / DISAGREE”. Participants in the intervention group were then additionally prompted to generate a structured plan for task completion (also known as an ‘implementation intention’)[5] by completing the item: “I will log onto the website at……….(time) on …….(day) before/after ……….(e.g. I will complete the task at 5pm on Friday after work)”.

**Analysis**

Median splits were used to divide participants into skilled (M=22.2/30, SD=3.4) and poor planners (M=14.3/30, SD=2.4) on the basis of planning skill. The group scores equated to approximately +/-1SD above and below average in the appropriate age range of the D-KEFS normative sample[25]. Data were analysed using 2x2x2 log-linear analysis (<http://vassarstats.net/>) where A= planning skill (A1 – skilled, A2 – poor), B= outcome (B1-completed, B2-did not complete), and C= condition (C1- intervention, C2 – control).

**Results**

All participants indicated agreement to complete the task (i.e. intention did not differ between skilled and poor planners). Across the total sample n=83 (58%) completed the online diary within the specified time window. Task completion was more frequent in the planning intervention (67%) than control (49%) group.

Overall, there was a significant association between the intervention, planning skill and completion rate (G2=15.45, p<0.01). Receiving the intervention was associated with higher completion rates (G2 [BC] =4.84, p<0.05) but critically, and as illustrated in Figure 2, only in poor planners (G2[BC(A2)] =6.88, p<0.01) and not in skilled planners (G2 [BC(A1)]=0.26, p=NS). Similarly, although higher completion rates were associated with having higher levels of planning skill (G2 [AB]= 8.31, p<0.005), this effect was only evident in the control condition (G2 [AB(C2)]=9.61, p<0.005), disappearing when the planning intervention was used to compensate for low levels of planning skill (G2[AB(C1)] =1.0, p=NS). Across the whole sample, the point bi-serial correlation between planning skill and successful task completion was r=.199; p=.03 indicating a direct relationship between planning skill and subsequent behaviour.

*{insert Figure 2 about here}*

**Discussion**

Over both a predictive and an intervention study, the present results indicate that the beneficial effect of planning for subsequent intended behaviour is dependent on the skill of the planner. In study 1, action plans spontaneously generated by poor planners were less effective in determining subsequent snacking behaviour than those generated by skilled planners, suggesting that skilled planners produce more effective plans. In study 2, poor planners (but not skilled planners) benefited from an intervention which prompted generation of a high quality plan (an implementation intention) suggesting that structured planning interventions can be used to compensate for low levels of planning skill. These results may explain recognised inconsistencies in the planning literature[14], as plans will only be as good as the people who make them.

So what constitutes a “poor” planner? Planning is heavily dependent on the ‘executive functions’[16] and involves several executive sub-processes. Planning tasks require participants to identify the sub-goals required in the pursuit of a superordinate goal, sequence these sub-goals correctly and efficiently, detect and correct errors as they occur, hold multiple (sometimes conflicting) pieces of information in mind at the same time, and maintain sustained cognitive effort over time. Individuals with below average performance on planning tasks are likely to have relatively weak or inefficient executive function and to be less able than others to perform the effortful cognitive operations required for plan generation and implementation. In line with this, suboptimal executive function has been linked to problems in the control of snacking behaviour[27] and to a reduced ability to perform intended actions (medication adherence) within specified time windows[28]. It is possible that the observed relationship between planning and goal attainment reflects differences in an underlying third variable (not measured in the present study) such as general intelligence. However, recent evidence suggests that executive function predicts effortful dietary regulation independently of intelligence[29] . Similarly, it is possible that good planners are capable of making quick and accurate plans, but that these technically accurate plans would be unrealistic or impossible to implement in complex, real life contexts. Future studies should explore the generalisability of the present findings to complex real world planning situations.

Why do good planners not benefit from planning interventions? Although it is possible that good planners do not benefit from planning interventions because they spontaneously generate high quality action plans, this could not be directly tested in Study 2 as action planning was not assessed. However, the results of Study 1 revealed no significant association between planning skill and spontaneous use of actions plans, suggesting that good planners are not simply generating more plans spontaneously. It is nevertheless possible that they generate better plans in terms of feasibility. Alternatively, since planning is part of the more general set of abilities characterised as executive functions, it is possible that skilled planners are more generally equipped to achieve goals (e.g. through enhanced ability to not just plan, but also to maintain attention on goals / inhibit inappropriate actions, remember to act when opportunities arise, and so on).Rather than improving planning skill by teaching people to plan, implementation intentions compensate for inefficiencies in executive functioning by allowing lower level, non-executive processes to determine behaviour. Implementation intentions are thought to pass control of behaviour to the environment[5] by establishing an advance link between an environmental cue and action so that action is automatically elicited when the specified cue is encountered. Allowing behaviour to be elicited automatically in this way would be expected to circumvent the need for effortful executive functioning[30]. The idea that implementation intentions compensate for executive dysfunction has been raised in the literature before[31], following studies which demonstrated that implementation intentions are more beneficial in clinical groups with notable executive dysfunction[32,33]. Implementation intentions have also been shown to improve the performance of tasks with a strong executive component[34,35] and to compensate for depletion of self-regulatory resources (which have considerable conceptual overlap with executive control resources)[36].

Although the present research demonstrates that planning interventions only benefit people with low levels of planning skill, it does not detract from the usefulness of planning interventions. Our results suggest that with simple tasks such as those used in the present study, implementation intentions will help poor planners to achieve their goals, and that those who do not benefit (skilled planners) are already able to achieve their goals. As cognitive resources are finite, and task performance suffers when limits are reached, it is likely that as task complexity increases, even skilled planners’ ability to achieve goals unassisted will decline. At the point where demands exceed available cognitive resources, we might expect to see skilled planners begin to accrue benefit from planning interventions that reduce the need for conscious cognitive control.

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**Figure 1: Interactive effect of spontaneous action planning and planning skill on snacking one week later (Study 1)**

**Figure 2: Number of participants successfully completing online food diary within specified timeframe (Study 2)**



**Table 1: Correlation matrix showing relationships between intentions to limit snacking, snacking behaviour, action planning and planning skill (Study 1)**

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 **Intention Behaviour Action Planning Planning Skill**

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**Intention** .243\* (.040) -.342\* (.003) -.297\* (.011)

**Behaviour** .243\* (.040) -.097 (.418) .185 (.119)

**Action planning** -.342\* (.003) -.097 (.418) .022 (.853)

**Planning skill** -.297\* (.011) .185 (.119) .022 (.853)

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**Table 2: Multiple hierarchical regression predicting snacking behaviour from planning skill, intentions and action planning (Study 1)**

**Step Variable B Std Beta t p *R R2 Std p***

**Err *Err***

***\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

1 *.062 .004 .691 .876*

 (constant) 2.457 .484 5.078 .000

 Age .009 .022 .050 .414 .680

 Gender -.062 .219 -.034 -.285 .776

2 *.372 .138 .657 .022\**

 (constant) 2.254 .476 4.739 .000

 Age .014 .021 .076 .651 .518

 Gender .067 .216 .037 .311 .757

 Planning skill .004 .002 .280 2.326 .023\*

 Action planning -9.8E-5 .062 .000 -.002 .999

Intention .322 .123 .345 2.607 .011\*

3 *.443 .196 .639 .034\**

 (constant) 2.303 .464 4.968 .000

 Age .012 .021 .068 .600 .551

 Gender .037 .211 .020 .177 .860

 Planning skill .004 .002 .313 2.653 .010\*

 Action planning .025 .062 .050 .410 .683

 Intention .325 .120 .348 2.703 .009\*

 Planning skill \* Action planning .003 .001 .248 2.161 .034\*

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**