2015

Backward Planning: Examining Consequences of Planning Direction for Time Prediction

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BACKWARD PLANNING: EXAMINING CONSEQUENCES OF PLANNING DIRECTION FOR TIME PREDICTION

by

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Honours Bachelor of Arts, Psychology, Wilfrid Laurier University, 2009

Master of Arts, Psychology, Wilfrid Laurier University, 2011

DISSERTATION

Submitted to the Department of Psychology

in partial fulfilment of the requirements for the degree of

Doctor of Philosophy in Psychology

Wilfrid Laurier University

Abstract

Research examining the “planning fallacy” indicates that people frequently underestimate the time needed to complete tasks, and that this underestimation bias stems from a tendency to base predictions on plans that are idealized and oversimplified. The present research tested a potential debiasing strategy – known as backward planning – that involves beginning with the future target goal in mind, and working backwards toward the present by imagining all the steps needed to attain that goal in a reverse-chronological order. It was hypothesized that by altering the temporal direction of planning, this approach may lead people to have greater planning insights (i.e., clarify planning steps, think of new planning steps, break plans down into important steps), and plan less idealistically (i.e., consider potential problems and obstacles), which would in turn lead them to make more conservative predictions. Results from four experiments supported the prediction hypothesis. Participants assigned to the backward planning condition predicted to finish a variety of hypothetical tasks (Studies 1 & 2) and real, upcoming projects (Studies 3 & 4) later than participants in the other conditions. Further, in a follow-up study that tracked actual completion times (Study 4), backward planners were found to be less biased in their predictions than participants in the other conditions. Lastly, as predicted, backward planners reported more planning insights and potential problems and obstacles (Studies 1, 2, & 4) than those in the other conditions. Hypotheses concerning mediating processes received some support (Studies 2 & 4). These studies are the first to test the effects on prediction of a planning strategy commonly advocated in applied contexts, and provide some evidence that backward planning helps individuals

generate more realistic predictions by influencing cognitive processes that normally lead to bias.

Acknowledgements

First and foremost, I would like to thank my advisor Dr. Roger Buehler for his mentorship and guidance over the past several years. I would also like to thank my committee members Dr. Anne Wilson and Dr. Christian Jordan for their helpful comments and suggestions on earlier drafts of the thesis, as well as Dr. Ian Newby-Clark and Dr. Hae Joo Kim for agreeing to serve as external readers.

Additionally, I would like to acknowledge my family, especially my parents Brad and Holly Wiese, and Barbara Aldworth, for their love and support. I am also very grateful to Brad Evans for his unconditional love, support, and encouragement, Chris and Terry Evans (and family), and Sue and Patrick Blackham (and family) for their support, generosity and encouragement over the years. I would also like to thank Mary Hogan for her generosity and guidance, and Enoch Landau for his support and friendship. Lastly, I would like to dedicate this dissertation to my granny Angela. Her memory serves as constant inspiration and a reminder of the value of hard work and perseverance.

Anfangen ist leicht, beharren eine Kunst (to begin is easy, to persist is art).

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This program of research examines a strategy intended to improve people's ability to estimate project completion times accurately. Improving prediction accuracy is not only of theoretical interest to psychologists, it is practically important to individuals and organizations who expend a considerable amount of time and resources attempting to estimate project completion times accurately. People have difficulty making accurate estimates of how future tasks and events will unfold; in particular, there is a general tendency to underestimate how long tasks will take to complete despite knowledge of past failures to keep deadlines (Kahneman & Tversky, 1979). This underestimation bias appears to stem, in part, from people's natural inclination to rely on optimistic schemas when generating plans for the future (Buehler, Griffin, & Ross, 1994; Newby-Clark, Ross, Buehler, Koehler, & Griffin, 2000). The present research tests the effectiveness of an approach – backward planning – that is widely advocated in applied contexts (Lewis, 2002; Verzuh, 2005). Backward planning involves beginning with the future target goal in mind, and working backwards toward the present by imagining all the intervening steps needed to attain that goal in a reverse-chronological order. We theorize that by reversing the temporal direction of planning, people will rely less on optimistic schemas and scripts when generating plans, and will be more inclined to identify potential problems and obstacles that could arise during goal pursuit. In this sense, backward planning is an intriguing strategy as it gets people thinking about the future in a different way while still capitalizing on their natural predisposition to focus on plan-based scenarios when making predictions. Through a series of studies, we test the hypothesis that backward planning results in longer and thus more realistic predictions of task completion time, and we explore psychological processes (e.g., a focus on problems and obstacles) that may underlie this effect.

The Planning Fallacy

Governments, businesses and individuals have a difficult time making accurate predictions of how future tasks and events will unfold. In particular, there is a general tendency to underestimate how long tasks will take to complete despite knowledge of past failures to keep deadlines. This prediction bias – making optimistic predictions despite knowledge of past failures – is referred to as the “planning fallacy” (Kahneman & Tversky, 1979). People routinely succumb to this bias while carrying out a wide range of personal, academic and work-related tasks (Buehler & Griffin, 2003; Buehler et al., 1994; Kruger & Evans, 2004; Roy, Christenfeld, & McKenzie, 2005). Moreover, the bias has been shown to generalize across personality factors such as trait optimism (Buehler & Griffin, 2003; Weick & Guinote, 2010) and procrastination (Buehler & Griffin, 2003; Pychyl, Morin, & Salmon, 2000). In order to understand why people are prone to this bias, it is important to understand how people conceptualize and plan for future tasks.

Thoughts about the Past, Predictions for the Future

Research has shown that people base task completion predictions on their specific plans for carrying out a future target task, and that relevant past experiences are often overlooked (Buehler et al., 1994; Buehler & Griffin, 2003; Buehler, Peetz, & Griffin, 2010; Dunning, 2007; Epley & Dunning, 2000; Kahneman & Lovallo, 1993). This is not a function of thought suppression or wilful ignorance, but rather a result of the cognitive processes that are engaged when people think about and plan for the future. Specifically, planning and prediction are naturally future-focused processes where individuals rarely pause to reflect on relevant past experiences. Further, even if people do consider their past experiences, they routinely fail to see their similarity and relevance to the task at hand, and as a result, fail to appropriately integrate and utilize those experiences when making plans and subsequent predictions (Kahneman & Lovallo, 1993). People may also make attributions that diminish the relevance of past experiences, especially when the end result was negative (e.g., a past missed deadline); in these instances, individuals are inclined to excuse negative outcomes in a way that diminishes their relevance to the self (Miller & Ross, 1975; Taylor & Brown, 1988). Further, attention to and awareness of the past is not enough to make it relevant and influence prediction; people who are specifically focused on the past still underestimate completion times (e.g., Buehler & Griffin, 2003). The incorporation of past experiences into plans is not something that individuals are naturally inclined to do; it is only when participants are explicitly told to do so that the optimistic prediction bias is eliminated (Buehler et al., 1994, Study 4).

Thoughts and Predictions about the Future

Why would disregard for the past and a focus on future plans and scenarios result in optimistically biased predictions? Previous research suggests that this reflects people's cognitive representation of future events. According to temporal construal theory (TCT) (Liberman & Trope, 1998; Trope & Liberman, 2003), although any future event can be construed at different levels of abstraction, people tend to focus on abstract and decontextualized construals of events – at least for those occurring in the relatively distant future. More generally, representations of future goal pursuit tend to be based on schemas, which are knowledge structures informed by aggregated information about the world that offer simplified scripts for the way that future events are likely to unfold

(Anderson, 1990). As a result, mental representations tend to be simplified and idealistic rather than accurate, comprehensive and thorough (Bartlett, 1932; Tse et al., 2007). For example, when participants were asked to "think out loud" and predict when they would complete a specific personal project, they typically discussed a highly idealized, multi-step plan that failed to reference potential obstacles (Buehler et al., 1994; Newby-Clark et al., 2000). Thus, the natural inclination to base predictions on a future plan is problematic because plans tend to focus on a few key elements and generally fail to consider peripheral or non-schematic features (Dunning, 2007; Liberman, Trope, & Stephan, 2007) or the many alternative ways an event could unfold (Hoch, 1985; Griffin, Dunning, & Ross, 1990). Further speaking to plan idealization, people tend to be heavily biased towards positive rather than negative information and outcomes when planning (Newby-Clark et al., 2000) and are prone to a form of "fantasy" wherein they envision their future goal pursuit going as smoothly as possible. Indeed, people tend to focus on this idealized future and imagine working through their planning steps seamlessly from the beginning to the end.

Along similar lines, theory and research suggests that individuals do not make adequate allowance for obstacles or barriers that may prevent them from carrying out their plans (Buehler & Griffin, 2003; Griffin & Buehler, 1999; Koehler & Poon, 2006). Kahneman and Tversky (1979) noted that people are overly optimistic when it comes to making plans and judgments for the future due to an unwarranted surplus of confidence. Consistent with this view, individuals were found to make similar predictions whether they were instructed to base the predictions on "best guess" or on "best case" scenarios (Newby-Clark et al., 2000). People routinely fail to anticipate common obstacles such as difficulty getting started, scheduling conflicts, unanticipated events, distractions and temptations, missed opportunities to advance goal progress, and the failure to maintain pursuit of a prioritized goal in the face of competing goals (Ajzen, 1991; Bandura, 1997; Carver & Scheier, 1998; Molden & Dweck, 2006) which in turn, has a significant effect on their predictions. Further, Poon, Koehler, and Buehler (2014) found that people focused more on their good intentions than potential obstacles or competing demands which led to a surplus of optimism when making predictions. Interestingly, these researchers noted that even when considering these potential barriers, participants still placed too much weight on their good intentions when predicting their future behaviour.

In addition to these cognitive processes, motivational factors can play a role. People underestimate task completion times when they are strongly motivated to complete a task early (Buehler, Griffin, & MacDonald, 1997; Byram, 1997), when they have a desire to impress other people (Pezzo, Pezzo, & Stone, 2006), and when they are given monetary incentives to complete a task quickly (Brunnermeier, Papakonstantinon, & Parker, 2008). There are also emotional benefits for making overly optimistic predictions. According to Brunnermeier et al.'s economic model of the planning fallacy, people make optimistic predictions partly because they are motivated to expect that a future task will not take a lot of time and effort to complete. The belief that future task completion "won't be too hard" provides immediate psychological benefits (e.g., reduced stress and increased well-being). Based on economic models, the authors argue that due to their immediacy, these benefits outweigh the future costs of end-stage rushing that are the result of initial, motivated task underestimation.

Effect of Idealistic, Problem-Free, Future-Focused Planning on Prediction

The literature reviewed above suggests that people tend to underestimate task completion times because they ignore past experiences, rely on mental representations of the future (i.e., plans and mental scenarios) that are overly simplified, idealized, or schematic, and fail to account for potential problems and obstacles that could arise during goal pursuit. Consistent with this reasoning, Buehler and Griffin (2003) found that this type of thought focus (i.e., a focus on a plan or scenario) led people to generate overly optimistic estimates of task completion time for a variety of tasks (e.g., Christmas shopping, school project). Bias was increased because a focus on plans affected people's predictions of when they would finish a task, but did not carry through to influence when they actually completed the tasks (Buehler & Griffin, 2003). There are some exceptions to this pattern, wherein predictions do affect actual completion times (e.g., Buehler et al., 2010), which will be discussed in more detail in a later section.

Overly optimistic predictions of task completion time are problematic because of the many negative consequences associated with a chronic failure to meet predicted deadlines, such as increased costs (Hall, 1980), and more personally, decreased well-being and lower life satisfaction (Austin & Vancouver, 1996). Thus, it would be beneficial to identify factors that may eliminate or reduce people's natural inclination to generate overly optimistic plans and predictions. The main purpose of the present research was to test the effectiveness of a planning strategy that might help people avoid the usual drawbacks of planning.

Debiasing Strategies that Attenuate the Planning Fallacy

In addition to the backward planning strategy examined in the present work, researchers have identified several other methods that can reduce optimistic prediction bias. The following section will briefly review four strategies most relevant to the current research on planning and prediction.

Reference class forecasting. People commonly take an inside view when making predictions where they focus on the task at hand and create plans and scenarios for that specific task based on schemas and scripts. On the other hand, reference class forecasting (or taking an outside view) eschews planning altogether and instead focuses on the comparison of a current task with a reference class of similar projects that have already been completed (Flyvbjerg, 2008; Kahneman & Lovallo, 1993). The main advantage of taking an outside view is that it circumvents the pitfalls of schematic, scenario thinking by focusing on distributional information of a class of similar cases (Dawes, 1988). However, Kahneman and Lovallo (1993) note that this strategy only works when a suitable reference class is available for comparison, such as in the case of familiar projects and events, but would be less useful when dealing with novel and unfamiliar tasks and projects.

Unpacking. Another debiasing strategy that has been shown to influence prediction is task unpacking (Hadjichristidis, Summers, & Thomas, 2014; Kruger & Evans, 2004; Rottenstreich & Tversky, 1997). Kruger and Evans (2004) argued that the planning fallacy occurs because people view tasks holistically and generate simplistic and incomplete plans as a result. Instead, people should “unpack” projects into their specific subcomponents, and consider them when making predictions. Through a series of experiments, it was found that when prompted to unpack a variety of tasks (e.g., preparing for a date, preparing food, document formatting) into their various subcomponents, participants made longer – and less biased – predictions than participants in the packed conditions. Further, the debiasing influence of unpacking was found to have greater influence on more complex tasks. Concerning possible mechanisms for unpacking effects, Liu, Li, and Sun (2014) found that unpacking led to greater perceived temporal distance of a given time interval; unpacking signalled all the things that still needed to be done, and all the time that it would take to do them.

Hadjichristidis et al. (2014) found that the focus of unpacking also matters. For example, when difficult facets of a document formatting task were unpacked (vs. short and simple facets), the planning fallacy was reduced. The authors argued that this occurred because a focus on difficult aspects during mental simulation signalled the impending difficulty of the task to the participant who then adjusted their predictions accordingly. In another experiment, the researchers found that a focus on temporally early (vs. late) unpacked components of a task focused participants on all of the things that would still need to occur before the goal was reached, which in turn led to reduced prediction optimism. The authors noted that unpacking effects appear to be due to an increased awareness of temporal factors and effort requirements.

Visual imagery perspective. In another line of work, Buehler, Griffin, Lam, and Deslauriers (2012) identified visual imagery perspective as an additional factor that reduced optimistic prediction. In general, individuals adopt either a first-person perspective, where they see events unfolding from the same visual perspective as they would if they were actually experiencing it ("through their own eyes"), or a third-person perspective, where they see events (including themselves) unfolding from an outside observer's visual perspective ("through the eyes of someone else") (Libby & Eibach, 2011). When the effect of adopted visual perspective on prediction was examined, it was found that participants who imagined an upcoming task from a third-person (vs. first-person) perspective focused less on optimistic plans and more on potential obstacles which in turn led them to make less optimistic completion time predictions. Similar to actor-observer effects on prediction (Buehler et al., 1994; Newby-Clark et al., 2000), the authors argued that imagining a future task from a third-person perspective reduced psychological processes (e.g., a focus on optimistic plans) that contribute to prediction bias. Although this strategy offers benefits, people are not naturally inclined to adopt a third-person perspective; Buehler et al. (2012) found that approximately two thirds of participants spontaneously adopted a first-person imagery perspective whereas only one third adopted third-person imagery perspective.

Implementation intentions. Implementation intention planning involves linking a future situational cue to a pre-determined goal-directed behavioural response (Gollwitzer, 1993; 1999; Gollwitzer & Brandstätter, 1997). For example, an individual with the goal of maintaining a vegetarian diet could form an implementation intention where they link a specific situational context (e.g., a friend asking them where they would like to eat dinner) to an appropriate behavioural response (e.g., suggest a trip to a vegetarian restaurant). A meta-analysis conducted by Gollwitzer and Sheeran (2006) that involved 94 studies and over 8,000 participants reported a medium-to-large effect size (d = .65) of implementation intentions on goal achievement.

Concerning implementation intentions and the planning fallacy, Koole and van't Spijker (2000) utilized a report assignment paradigm developed by Gollwitzer and Brandstätter (in Koole & van't Spijker) that had participants complete a report writing task. They found that although having participants make implementation intentions led to optimistic finish time predictions, it also led to a reduction in interruptions while working on a task, which in turn led to greater goal completion (and consequently, a reduction in optimistic bias). It seems as though participant thoughts about specific future scenarios and how they would react led them to appropriately handle interruptions during actual goal pursuit. Although implementation intention planning has been shown to reduce optimistic bias, it is possible that the effect would not have been so robust had they used more complex tasks or a wider range of novel target tasks and goals. Another concern with implementation intentions is that the selection of some vital future context and subsequent mental representation to act as a cue to prompt goal-relevant action initially relies not only on memory and past experiences (Kuhl, 1994), but also on forecasts of the future. This is not ideal considering that one's memory for the past is often inaccurate (e.g., Roy, Mitten & Christenfeld, 2008), incomplete and filled with errors; and as mentioned previously, forecasts of the future tend to follow scripts and to be overly idealized (Robinson, 1988). Thus, if one's actions are contingent on pre-established environmental cues that are derived from faulty memories and script-based forecasts, then one may fail to recognize novel situations during actual goal striving that could advance goal-progress. A person may also fail to consider potential obstacles when planning, and as such, fail to generate implementation intentions for unanticipated events.

What is needed is a general strategy that moves people away from schematic thinking so that they are able to more accurately conceptualize the future and make more realistic predictions of when they will finish tasks. Backward planning may be one such strategy.

Backward Planning

"Backward planning" or "backward goal setting" is a planning approach that has gained popularity in applied contexts such as project management and education (Lewis, 2002; Verzuh, 2005). Whereas people typically plan for their future projects in a forward, step-by-step manner (Buehler & Griffin, 2003), the backward planning approach involves beginning with the future target goal in mind, and working backwards toward the present by imagining all the intervening steps needed to attain that goal in a reverse-chronological order. We seek to test whether the backward planning approach can reduce an optimistic prediction bias and to explore potential processes that may be underlying the effects. Specifically, we will be focusing on a cognitive process that is highly relevant to people's predictions of how future tasks will unfold – thoughts about potential problems and obstacles – and how backward planning may be a strategy people could use to conceptualize future goal progress less schematically to generate more realistic plans which would in turn lead to more realistic predictions.

In most cases, planning is done chronologically, with individuals outlining their planning steps in a sequential order from the present towards a desired goal or endpoint (Buehler & Griffin, 2003; Griffin & Buehler, 1999; Koehler & Poon, 2006). Even implementation planning – which appears to be non-linear stimulus-response planning – tends to be chronological with people identifying situational contexts and responses in the order that they would likely emerge in real life (Gollwitzer, 1999). As previously mentioned, a potential problem is that people are inclined to follow schemas and scripts while engaging in typical forward planning which leads them to generate overly idealistic plans and expectations of completion times. By reversing the temporal direction of planning, backward planning is likely to disrupt schematic and script-based thinking. It is thought to be an effective strategy because it encourages planners to view a project from an alternative perspective which may lead them to attend to non-schematic information (e.g., problems and obstacles) that may have otherwise been overlooked (Lewis, 2002; Verzuh, 2005). Now, it should be noted that backward planning is not in itself a pessimistic strategy that focuses people on the many things that could go wrong during goal pursuit; the strategy only offers a new perspective for people that may lead to the identification of new plans and insights, including obstacles. This is an important distinction to make in light of research by Newby-Clark et al. (2000) who found that asking people to generate pessimistic scenarios that focused only on potential problems and obstacles was not an effective debiasing strategy. The authors noted that pessimistic plans did not influence prediction because people found these scenarios less plausible than more optimistic ones.

Applications of Backward Planning

One place where backward planning has been utilized is in the highly complex contexts of sustainable development (Bagheri & Hjorth, 2007; Dreborg, 1996; Holmberg, 1998) and socioeconomic resource policy modelling and forecasting (Robinson, 1982; 1988) where it is sometimes referred to as “backcasting”. Lovins (1976) first proposed the backward planning strategy as an alternative to typical forward planning when dealing with the creation of large-scale energy policies. As noted in implementation intention research (Gollwitzer, 1999), if a future planned action is based on past experiences and script-based forecasts, then it is likely that only “typical” events will be accounted for in plans for the future. This may be especially disadvantageous in the case of large-scale projects due to the costs associated with unanticipated problems and obstacles (Hall, 1980). It is also problematic to simply extrapolate current trends into the future. In the case of energy, Lovins (1976) reasoned that future energy demands will undoubtedly reflect current policy choices, thus it would be most useful to first illustrate a desirable future and then plan out how that end-state could be realized through current policy changes (rather than making predictions based on a continuum of present trends simply projected into the future). It is risky to base one's plans for the future solely on past and dominant trends especially if those factors are the main source of the present problems. For example, if a country wants to reduce its energy consumption, it will not want to look to past policy decisions to inform new policy because they were based on energy demands that have likely been deemed unsustainable over the long-term (Holmberg & Robèrt, 2000). Robinson (1988) notes how the technique of backcasting helps people shift away from trends and "likelihoods" to help them attend to other kinds of information and possibilities for the future. In practice, backcasting has been used by researchers in the European Union (EU) as a way to design policy paths that will meet future goals (e.g., the EU's goal of having a sustainable transport system by 2020). The strategy has also been used to meet similar forecasting needs for Baltic Sea futures exploration (Dreborg, Hunhammar, Kemp-Benedict, & Raskin, 1999) and growth projections for IKEA (Holmberg, 1998).

In addition to the application of backward planning to large-scale, complex systems as a way to accurately predict the future, an increasing amount of attention is being focused on the implementation of backward planning in smaller contexts such as educational, business and project management. Wiggins and McTighe (1998) created a popular method for curriculum design and classroom planning they termed "understanding by design (UbD)". UbD utilizes a backward design paradigm where teachers first identify the key concepts and learnings that they want their students to acquire, and then plan the curriculum, assessments and lectures in a backward direction from those goals. In this manner, the strategy is thought to help teachers clarify the learning goals for the classroom, design the course in a goal-congruent way, and have the summative course assessments clearly test the appropriate knowledge and concepts.

In business and project management contexts, practitioners frequently make use of backward planning (Lewis, 2002; Verzuh, 2005). The "backward pass" method is often used to calculate the critical start and finish dates of individual steps within large, multi-step projects where the completion of preceding steps is crucial for advancement onto the next step. To do this, the latest possible finish-time for a task must be identified with steps planned back from there. The backward pass strategy is said to encourage planners to identify the critical path, that is, the absolute latest starting and finishing time for each step that would still allow the deadline to be met. The strategy is also said to help people organize competing goals and steps. Backward planning is also said to help avoid the problem of "back-end loading" (Lewis, 2002) where individuals end up doing the majority of the work right around the deadline because they failed to anticipate how long each individual step would take in their initial plans. This idea is supported by research on a "segmentation effect"; when people estimate the time needed to complete each of their individual planning steps, the sum of these predictions is generally larger than overall estimates (Forsyth & Burt, 2008).

In addition to the application of backward planning to both complex systems and organizational contexts, there is an abundance of information available online that extends the strategy to more personal contexts such as career planning, event planning, academic goals and personal projects. Interestingly, many online sources describe the backward planning strategy and tout the benefits of it without offering any evidence to support their claims. For example, one article posted on a website devoted to homework tips claims that the backward planning strategy helps students clarify plans, organize their time and generate a clear and realistic picture of what needs to be done (Fleming, 2010). The article provides instructions on how to backward plan, but offers no evidence to support the claim that the strategy is indeed useful and leads to better time management. Another article posted on Berkeley's Centre for Student Leadership website claims that the strategy offers planners a new perspective and helps them map out exactly when milestones and specific things need to be accomplished (Rutherford, 2008). Once again, the author outlines the steps of successful backward planning, but does not offer any evidence to support the claim that backward planning is an effective time management tool. Likewise, according to the Ball Foundation (2007), backward planning helps people anticipate obstacles and understand how planning steps are related and often dependent on one another. No empirical support, however, is extended to the reader to support these statements. In a self-published book, one author claims that the strategy helps people manage their time by making people organize their smaller goals relative to their end goal (Saintamour, 2008). Additionally, as part of their visions and goals program, Lululemon (2015) created a video describing the backward planning technique and how it can be used to plan for long term goals. Viewers are told to imagine their ideal selves in 10 years' time, and to plan backwards from there to the present, identifying specific milestones that will need to be reached – and by when – along the way. It is suggested that by planning backwards from an idealized goal, people are able to make more targeted plans and set important milestones. Again, no evidence is provided to support the claim that this is a helpful strategy.

In sum, it has been suggested that backward planning helps people: (a) Identify more clearly the steps they will need to take, (b) appreciate how steps are dependent on one another, (c) recognize points of tension within a plan, and (d) anticipate potential obstacles that could arise during goal pursuit. Surprisingly, however, despite the widespread advocation and use of this strategy, there has been no systematic research examining its psychological consequences. The supporting evidence put forth is largely anecdotal; it exists in the form of hypothetical examples, opinions and single case instances, and in no case is there any attempt at understanding or explaining how the planning strategy is operating psychologically. Thus, given the popularity of the strategy, it is important to subject it to empirical scrutiny for both theoretical and practical reasons.

Theoretical Framework

We propose that backward planning elicits cognitive processes that result in more realistic predictions of task completion time. The theoretical framework that we will be drawing upon to examine the backward planning strategy concerns the role of temporal direction in cognition. Given that people tend to focus on plans that are based on idealized scripts (Bartlett, 1932; Tse et al., 2007), it seems plausible that backward planning should attenuate these tendencies. Altering the direction of recalled or forecasted events is one way to get away from schematic and script-based thinking. Travelling through events in a backward direction is a somewhat novel and unusual mental process, and thus may help planners break away from their usual modes of thinking and be more creative and insightful when contemplating the steps involved in their goal pursuit. In this manner, individuals should be less likely to fall into familiar or idealized scripts and more likely to consider non-schematic information (e.g., problems and obstacles) when they use backward planning. This process is anecdotally supported by work done in applied contexts. Additionally, some research on memory offers indirect support in line with this theorizing.

In the context of eyewitness testimony, a “backward recall” strategy has been employed as a key part of the eyewitness interview technique called “the cognitive interview” (Geiselman, Fisher, MacKinnon, & Holland, 1986). People’s memories are often inaccurate because they are influenced by schemas (in much the same way that mental representations of the future are influenced). As previously noted, schemas offer a script for the way events are likely to unfold which is why odd or incidental occurrences not characteristic of a given schema are often not recalled properly. For example, Bellezza and Bower (1982) demonstrated that schema-consistent actions were more accurately recalled whereas schema-inconsistent actions received poorer recall; something that poses a significant problem in the context of eye witness testimony. When past events are recalled in a chronological fashion, some individuals reconstruct their memories to fall more closely in line with their schemas of comparable scenarios which in turn leads to inaccuracies and false reports (Geiselman et al., 1986). Accordingly, Geiselman and Callot (1990) proposed that backward recall might improve the accuracy of memory by breaking up the narrative structure of cognitive schemas. To test this hypothesis, they had participants listen to a passage, and after completing a distractor task, had them recall the passage in either a forward or backward direction. It was found that more script-incongruent, incidental details were recalled in the backward than forward condition while more script-congruent details were recalled in the forward than backward condition. It was also found that those who used forward recall made significantly more recall errors than those who utilized backward recall. In sum, backward recall was also found to facilitate recall clarity, the recall of important aspects of an event and confidence in the accuracy of recalled memories.

We suggest that similar processes might occur when people imagine themselves pursuing future goals. As discussed previously, people's plans may be heavily guided by generalized schemas or scripts, and thus they may fail to anticipate potential problems and obstacles which will lead them to make overly optimistic predictions. Thus, we suggest that forms of planning (e.g., backward planning) that move people away from schematic, script-based contingencies would prompt individuals to break away from such modes of thinking, identify points of contention in their plans, and make more realistic predictions of when they will complete tasks.

Anchoring Effects

Note that we have proposed that backward planning will result in longer predictions of task completion time, and thus will tend to reduce the underestimation bias commonly found in past research. This hypothesis assumes that differences in prediction created by backward planning are not accompanied by an equivalent effect on actual completion times. Previous research has generally found that factors that impact predictions of task completion time do not carry on to influence behaviour to the same degree. However, in an extensive examination of the behavioural impact of prediction, Buehler et al. (2010) identified a moderating factor; that is, whether the target task was "open" or "closed" to external interruption. An open task involves multiple work sessions over a span of time (and thus, even after it is started, remains open to interruptions and delays from external factors) whereas a closed task occurs in a single, continuous session. The authors used anchoring manipulations based on work done by Cervone and Peake (1986) to influence predictions and found that generating optimistic predictions led people to complete closed – but not open – tasks earlier than they would have otherwise.

Of particular relevance to the current research on backward planning is the anchoring manipulations used by Buehler et al. (2010). To manipulate predictions, participants were presented with a timeline that included dates spanning from the present to a future deadline. The experimenter moved a sliding arrow across the timeline beginning at either the present (early anchor condition) or the deadline (late anchor condition) and instructed participants to have her stop when the arrow reached the point on the timeline that represented when they thought they would finish the task. Previous research has found that referencing starting versus stopping points has different effects on prediction; specifically, people focused on the starting point make earlier predictions than people focused on the deadline (LeBoeuf & Shafir, 2009; Paese, 1995; Sanna, Parks, Chang, & Carter, 2005). In line with these findings, Buehler et al. (2010) found participants made more optimistic predictions (i.e., earlier completion times) in the early than in the late anchor condition, and these predictions went on to influence the completion of closed but not open tasks. Thus, our anticipation of a null effect of prediction on completion time is theoretically consistent given that the present research utilizes open target tasks.

In a related series of studies, LeBoeuf and Shafir (2009) elicited early or late predictions by altering the manner in which the questions concerning predictions were asked. Specifically, participants were asked "How many days until…" to anchor them to the present, or "On what date…" to anchor them to the deadline. Results show that participants anchored to the present systematically underestimated the time needed to complete various tasks whereas participants anchored to the deadline made less optimistic estimates. The authors suggest that this occurred because early-anchor participants were making predictions based on insufficient temporal adjustments from the anchor. In line with this reasoning, it was found that participants who responded in small units (e.g., days) versus large units (e.g., months) underestimated to a greater degree, which suggests that the systematic underestimation exhibited by early-anchored participants may indeed be due to insufficient temporal adjustment from the present.

There are some similarities between backward planning and anchoring manipulations. It could be argued that backward planning simply anchors participants on the deadline which is what may drive any effects on prediction. Despite this reasoning, we argue that the effects of backward planning are not the result of anchoring. The anchoring manipulation had participants focus on either the start point or deadline, follow an arrow on a timeline and then stop the arrow from moving when it reached the point on the timeline that represented their prediction. In this manner, the prediction was made in the moment; as the arrow was being moved by the experimenter, away from the anchor. Unlike backward planning, this prediction exercise did not involve planning – participants were not asked to generate plans while the experimenter was moving the arrow. It is of course possible that participants were generating very quick, rudimentary plans as the arrow was moving, but this was not part of the instructions or a focus of the exercise. On the other hand, backward planning is explicitly focused on the creation of a plan. Granted, participants who generate a backward plan also begin at the deadline, but unlike the anchoring manipulation, they are asked to identify all of the specific steps they will take to carry out the task, ending with the first step they will take. They are not solely focused on the deadline when making their predictions; they just begin the planning process there.

It is also the case the backward planners in our studies do not simply start at the deadline, think of their last step, and then make their predictions in that moment. They instead work through all of their plans for the entire time span and then move onto the next section of the study to make their predictions. All of their plans, from beginning to end, are available to inform prediction; and in fact, it could be argued that backward planners could become highly focused on the starting point since this is the last plan that they generate before making their predictions. Furthermore, if the hypothesized effects of backward planning on prediction are the result of deadline anchoring, then participant predictions of start times should also be closer to the deadline. We did not expect this to be the case, but were able to examine these predictions to test this possibility. We believe that effects of backward planning on predicted completion times will be created by the planning process itself – working through the individual steps needed to carry out the task – rather than by simple anchoring effects.

Other Factors that Influence Prediction

There are also other factors theoretically related to backward planning that have been shown to influence optimistic biases in prediction. These include: perceived difficulty of planning, temporal distance, subjective closeness, time pressure, motion perspectives and perceptions of control.

Difficulty of planning. Concerning the ease of generation theory (Sanna, Schwarz, & Kennedy, 2009; Schwarz, 2004; Schwarz et al., 1991), people who can easily generate thoughts or plans perceive them as being more likely, which in turn influences their predictions. For example, when people were asked to generate many (vs. a few) reasons that might lead them to complete an upcoming task successfully, they made less optimistic predictions. This is because generating many reasons was a difficult task to complete which made success seem less likely. Similarly, people who were asked to think of a few (vs. many) things that would cause them to miss their deadline made less optimistic predictions as thinking of a few things was easy to do. This suggests that difficulty affects perceptions of the probability of valenced events (i.e., positive or negative) which in turn influences predictions. Min and Arkes (2012) extended this work into the realm of planning and found that wedding planning participants who generated difficult, five step plans (vs. easier two step plans) made less optimistic predictions. They also found that business students who generated easy, two step pessimistic plans (vs. difficult eight step plans) also made less optimistic finish time predictions. These findings may be applicable to backward planning seeing that travelling through events in a backward direction is a new and somewhat unusual mental process and thus likely more difficult to do than forward planning. It could be the case that the difficulty associated with the planning exercise could make the plans themselves seem more effortful and thus less probable which could in turn result in longer predicted completion times.

Temporal distance. Temporal distance is another factor that has been shown to influence the level of optimism in predictions (Gilovich, Kerr, & Medvec, 1993; Liberman et al., 2007; Savitsky, Medvec, Charlton, & Gilovich, 1998). According to construal level theory (CLT), people tend to focus on low-level construals when thinking of an event in the near future; low-level construals tend to be specific, detailed and include peripheral features (e.g., potential obstacles) of the event. Alternatively, people focus on high-level construals when thinking of an event in the distant future; high-level construals tend to be schematic, simple and focus on central, abstract features of the event (Liberman, Sagristano, & Trope, 2002). As a result, people tend to make more optimistic predictions for events that are further away. This is because they rely on abstract, schematic, problem-free representations of the task that are void of thoughts of potential problems and obstacles when making predictions. Liberman and Trope (1998) found that participants believed they could accomplish more in the distant than near future. Participants were also less likely to consider potential time constraints and obstacles when thinking about the distant (vs. near) future. Further, in their work on “resource slack”, Zauberman and Lynch (2005) found that people expect to have more free time in the distant future than in the near future. This work implies that people are more likely to make optimistic predictions for distant events and generate more realistic predictions for events that are in the near future.

However, Peetz, Buehler, and Wilson (2010) noted that the concrete thinking associated with temporal proximity will not always lead people to make less optimistic predictions. This is because people can be focused on two very different types of concrete thoughts – plans for success and potential obstacles – which in turn affects how temporal proximity influences prediction. These researchers found that when participants were focused on potential obstacles, they made less optimistic predictions for close than for distant tasks. On the other hand, when participants were focused on plans, they made more optimistic predictions for close than for distant tasks. In sum, this work suggests that although temporal proximity to an event or task leads people to think more concretely about it, the type of concrete thoughts that people are focused on (plans vs. obstacles) also matters; step-by-step planning can lead to prediction optimism whereas a focus on obstacles leads to a reduction of this bias. Relating this work to backward planning, because the strategy is theorized to inherently focus people on potential problems and obstacles, it could be particularly useful when for planning for both close and distant goals.

Subjective distance. Another factor that has been shown to be related to prediction is subjective distance. Whereas temporal distance concerns the objective distance to an event or task, subjective distance concerns people's perceptions of distance to a task or event. Sanna et al. (2005) studied how temporal frames influence the planning fallacy. To do this, they had groups adopt a negative "little time remaining" frame or a positive "lots of time remaining" frame and make predictions of when they would complete a group project or in-lab desk assembly task. Results indicated that people who adopted a negative "little time remaining" frame made less optimistic predictions. The "little time remaining" frames led people to generate fewer thoughts about success which resulted in deadlines feeling subjectively closer in time. Thus, it could be that backward planning leads people to attend to non-schematic information (e.g., problems and obstacles) rather than thoughts about success, which could make them feel subjectively closer to their deadline, which in turn would lead them to make less optimistic predictions.

Conceptualizations of time. One last factor that could influence people's predictions concerns how people think about and experience time, and can be directly related to planning direction. In the English language, time is considered a directional entity. To illustrate this idea, we can consider how spatial metaphors are used in our language to talk about time: "looking *forward* to a brighter tomorrow", "falling *behind* schedule", and "proposing theories *ahead* of our time". Two dominant spatial metaphor perspectives have been identified: ego-motion and time-motion (Boroditsky, 2000; Clark, 1973). Ego-motion is when a person experiences time as progressing through it, toward the future. In the present context, we can see similarities between ego-motion and typical, forward planning where people progress through their plans from the present toward the future. On the other hand, a time-motion perspective is when a person remains still, and experiences time as moving toward them from the future. This is similar in some ways to backward planning, where people plan back from the future toward the present. In the course of everyday life, people alternate between the two perspectives relatively equally (Gentner, Imai, & Boroditsky, 2002)

Boltz and Yum (2010) examined whether these different conceptualizations of time (i.e., time and ego motion) influenced estimates of task completion time. In their studies, participants were presented with visual primes of either a time motion perspective (e.g., clouds moving toward the stationary individual) or an ego motion perspective (e.g., the individual moving toward the clouds) and were then asked to make predictions of how long it would take to complete a journal sorting and shelving task.

Results showed that participants with an ego motion perspective made overly optimistic predictions whereas those primed with a time motion perspective made less optimistic predictions. An ego motion perspective led participants to feel that the deadline was further away whereas a time motion perspective made a deadline feel subjectively closer in time and promoted a more realistic perception of the task (including potential delays, distractions and problems). The authors also suggested that an ego motion perspective is associated with a future focus whereas time motion is more directed toward the past, which may prompt people to consider past experiences to a greater degree when generating predictions. Motion perspectives were also theorized to be associated with feelings of control; when people have an ego motion perspective, they envision themselves in control of their movement toward the future whereas this sense of control is not felt by those with a time motion perspective. In a time motion perspective, the future approaches someone in a somewhat constant and inescapable way. Since control is associated with increased optimism, a time motion perspective that reduces feelings of control may also reduce optimistic bias. Thus, if it is true that forward planning evokes an ego motion perspective while backward planning evokes a time motion perspective, the associated perceptions of control may drive effects on prediction.

In their work on the temporal Doppler effect, Caruso, Van Boven, Chin, and Ward (2013) noted an inextricable link between the subjective experience of moving through time and movement through space. In particular, people rate the future (e.g., 1 week in the future) as feeling subjectively closer than an equivalent amount of time in the past (e.g., 1 week ago). This is because people are naturally future-focused, and can easily envision themselves travelling toward the future, thus making it feel closer in time.

In line with this reasoning, it was found that by disrupting the natural, forward trajectory of spatial movement by having participants travel backwards from the future using a virtual-reality device; the past-future asymmetry in perceptions of time was attenuated. In this manner, backward movement could also disrupt the natural flow of planning as well as influence perceptions of subjective distance.

The Present Studies and Hypotheses

The primary goal of the present research is to test the possibility that planning for a goal in a backward direction – by first imagining attaining the goal, and then envisioning the steps needed to reach the goal in a reverse-chronological order (i.e., moving backward in time from the goal toward the present) – is a strategy people could use to generate more realistic plans and completion time predictions. The main hypothesis was that backward planners would predict later task completion times than both forward planners and planners in an unspecified planning control group. It was also hypothesized that backward planning would disrupt people's natural tendency for schematic planning which would lead planners to experience greater planning insights and identify more potential obstacles than both forward and unspecified planners. For the reasons outlined above, these variables could serve to mediate the effects of backward planning on task completion predictions. Lastly, it was expected that backward planners would adopt a time (vs. ego) motion perspective to a greater degree than forward and unspecified planners. Measures of the difficulty of planning, subjective closeness, time pressure, and perceptions of control were also assessed to test as possible process variables.

To test these ideas, four studies were conducted that experimentally varied the manner in which participants planned for a variety of hypothetical and real-world tasks. The tasks varied widely in terms of type, importance, complexity, and scope, and thus allowed us to test the generalizability of the effects. Specifically, the studies examined the effect of backward planning on predictions for a hypothetical dating scenario (Study 1), a hypothetical school assignment (Study 2), and various real-life self-nominated goals (Study 3 and 4). Study 4 assessed both predicted and actual completion times, and thus provided a test of whether people generally underestimated their completion times, and whether backward planning reduced this underestimation bias. In all studies, participants were randomly assigned to plan for a target task using forward, backward, or unspecified planning. After planning for the task, participants made several predictions concerning the task, the key prediction being when they thought they would complete it. Participants also predicted when they would start the task and how long it would take them to complete it; however the finish time predictions were the key variable of interest, as most previous theory and research on the planning fallacy has focused on this type of prediction. In practical terms, too, people often measure task success in terms of whether they finish a task as expected, rather than the amount of working time it took, or whether they began when they thought they would (Buehler at al., 2010; Kahneman & Tversky, 1979). Thus, in the studies, although start and performance time are always examined, the primary outcome measure is the prediction of completion time.

Study 1

Date Scenario

In Study 1, participants were asked to imagine a standard, hypothetical task and plan the steps that they would take to complete it in a forward, backward or unspecified direction. An advantage of using a standard hypothetical task is that it affords a high degree of experimental control so that any effects that emerge can be attributed to the planning manipulation. However, to further explore the effects of backward planning on prediction once an initial effect was established, real-life target tasks were examined in subsequent studies (3-4). After planning for the hypothetical task, participants made predictions of when they would start and finish it, and how much working time it would take to complete it. They also answered several items assessing their thoughts and feelings about their plans, the planning exercise and scenario.

The main hypothesis was that backward planners would predict later task completion times than both forward and unspecified planners. There were no clear hypotheses for the measures of predicted start time and working time; these measures were included to gain a better understanding of the effects of planning direction on time prediction, and to possibly provide support to rule out alternative explanations (e.g., anchoring effects). It was also hypothesized that backward planners would report greater planning insights and identify more potential obstacles while planning than both forward and unspecified planners. In light of research that has shown that people predict later completion times to the extent that the context elicits a focus on obstacles (Peetz et al., 2010), the measures of planning insights and obstacles could function as mediators. That is, backward planning may lead people to think of additional steps or potential obstacles that they would not consider otherwise, which may in turn lead them to predict later completion times. However, it is also the case that people generally do not focus on problems and obstacles when considering hypothetical (vs. real) future events (Peetz et al., 2010). Thus, by using a hypothetical target task, we are providing a stringent test of the effect. Lastly, it was expected that backward planners would adopt a time (vs. ego) motion perspective to a greater degree than forward and unspecified planners. Participants' ratings of planning difficulty, perceptions of control, time pressure and subjective closeness were also assessed.

Method

Participants

Initially 239 undergraduate students from Wilfrid Laurier University were recruited for the study, however, seven participants were excluded because they did not fully complete the planning exercise (n = 4) or the dependent measures (n = 3). The final sample consisted of 232 undergraduate students (50 male, 179 female, 3 other identity) between the ages of 17 and 37 (*M* = 19.24 years, *SD* = 1.98 years) who participated in exchange for course credit.

Procedure

Participants were invited to complete an online questionnaire examining how people think about, plan for and make predictions regarding future events. Participants first provided demographic information including their age, gender, and year in university. Participants were then asked to engage in a visualization exercise of a hypothetical event, and to think about and experience the scenario as something that is real and happening to them. All participants were then presented with a scenario in which they needed to prepare for a dinner date (Kruger & Evans, 2004). In this scenario, the participant was to imagine that they had recently met someone and agreed to get together for a date at a restaurant the following Saturday at 8:00 p.m.

Following this, participants were asked to imagine that it was now Saturday at 2:00 p.m. and they had no plans for the afternoon except getting ready for the date. They were asked to develop a detailed plan of the actions they would need to take to prepare for the date. To guide their planning, participants were presented with a "timeline" spanning the period between the present (2:00 p.m.) and the time of the date (8:00 p.m.) broken into 30 minute intervals. Each interval was accompanied by an expandable text box, and participants were instructed to list each and every step they would have to take to get ready for the date in as much detail as possible. Participants were asked to list each separate step on a new line with a dash (-) and to state "no plans" in the text box for any time intervals that they did not expect to be preparing for the date.

To manipulate the temporal direction of their planning, participants were randomly assigned to one of three planning conditions: Forward, backward or unspecified planning. In the forward planning condition, participants received the following instructions:

> At this time, we would like you to list each and every step you would have to do to get ready for the date in as much detail as possible. Also, we want you to develop your plan in a particular way called forward planning. Forward planning involves starting with the very first step that needs to be taken and then moving onward from there to the end in a chronological order. That is, you should try to picture in your mind the steps you will work through in order to reach your goal (i.e., getting ready for your date) in a forward direction. Keeping your goal in mind, we would like you to use the timeline below to think carefully and imagine the main steps that you intend to use to reach your goal in a forward direction. Please work through the timeline listing all of your steps for each interval of time in a forward, chronological direction.

Corresponding with these instructions, the timeline was presented in a chronological order with the top text box labelled 2:00 p.m. and the bottom text box labelled 8:00 p.m.

In the backward planning condition, participants were given parallel instructions:

> At this time, we would like you to list each and every step you would have to do to get ready for the date in as much detail as possible. Also, we want you to develop your plan in a particular way called backward planning. Backward planning involves starting with the very last step that needs to be taken and then moving backward from there to the beginning in a reverse-chronological order. That is, you should try to picture in your mind the steps you will work through in order to reach your goal (i.e., getting ready for your date) in a backward direction. Keeping your goal in mind, we would like you to use the timeline below to think carefully and imagine the main steps that you intend to use to reach your goal in a backward direction. Please work through the timeline listing all of your steps for each interval of time in a backward, reverse-chronological direction.

Corresponding with these instructions, the timeline was presented in a reverse-chronological order with the top text box labelled 8:00 p.m. and the bottom text box labelled 2:00 p.m.

In the unspecified planning condition, the instructions did not specify what type of planning strategy to use. Participants in this condition received the following instructions:

> At this time, we would like you to list each and every step you would have to do to get ready for the date in as much detail as possible. That is, you should try to picture in your mind the steps you will work through in order to reach your goal (i.e., getting ready for your date). Keeping your goal in mind, we would like you to use the timeline below to think carefully and imagine the main steps that you intend to use to reach your goal. Please work through the timeline listing all of your steps for each interval of time.

Although the text boxes were again presented chronologically, participants were free to work through them in any order.

Time predictions. The primary dependent variable was the prediction of task completion time. Participants were asked to indicate the time (hour and minute) that they would be ready for the date. Participants also predicted the time that they would start getting ready for the date (i.e., task start time) and how long it would take to get ready for the date (i.e., task performance time).

After generating their time predictions, participants completed a series of measures concerning their perceptions of the planning exercise and their thoughts about the date scenario. Participants' perception of the backward planning exercise in comparison to the other forms of planning was of particular interest, and specifically whether backward planning resulted in novel thoughts or insights.

Perceptions of the planning exercise. Four items assessed participants' perceptions of whether the planning exercise resulted in new insights. Using a scale from 1 (*Strongly disagree*) to 7 (*Strongly agree*), participants rated the extent to which they believed that the planning exercise: "Helped me clarify the steps I would need to take to prepare for a date", "Made me think of steps that I wouldn't have thought of otherwise", "Made me break down my plans into important steps", and "Made me think of potential problems or obstacles I could encounter". These items were averaged to form an index of perceived planning insights with higher scores indicating more insights ($\alpha = .82$, $M = 4.02$, $SD = 1.25$).

Planning difficulty. Participants also rated the extent to which they believed that the planning exercise was a difficult task to complete using a scale from 1 (*Strongly disagree*) to 7 (*Strongly agree*).

Potential obstacles. Additional measures assessed some relevant thoughts and judgments about the target task. Four items were included to assess participants' beliefs about potential obstacles that could arise during their goal pursuit. Using a scale from 1 (*Not at all*) to 7 (*Extremely*), participants rated how difficult it would be to stick to the plan that they developed, and how likely it was that they would: "Need to carry out extra steps they didn't think to include in their plans", "Encounter problems when preparing for the date", and "Be delayed by interruptions or distractions from outside events". These four items were averaged to form an index of potential obstacles, with higher scores indicating a greater anticipation of obstacles (α = .67, *M* = 4.00, *SD* = 1.18).

Perceived control. Three items were included to assess participants' perceptions of control over the task. Using a scale from 1 (*Strongly disagree*) to 7 (*Strongly agree*), participants rated their agreement with the following statements: "I feel confident and in control of the situation", "I have control over how I prepare for my date", and "I have control over when I prepare for my date". These three items were averaged to form an index with higher scores indicating greater feelings of perceived control (α = .84, *M* = 5.96, *SD* = .97).

Time pressure. Using a scale from 1 (*Strongly disagree*) to 7 (*Strongly agree*), participants rated their agreement with the following statements: "I feel like I have a lot of time before the date" (reverse-scored), "I feel like I have enough time to prepare for the date" (reverse-scored), "I feel like I could use some more time to prepare for the date", "I feel under a lot of time pressure", and "I feel stressed about being able to get ready in time." These five items were averaged to form an index with higher scores indicating greater feelings of time pressure (α = .85, *M* = 1.85, *SD* = 1.01).

Subjective closeness. To assess the subjective temporal distance of the hypothetical task, participants rated the extent to which the date feels close or far away (1 = *Very close*, 10 = *Very far away*), with lower scores indicating greater feelings of subjective closeness.

Time motion perspective. To measure time motion perspective, participants were asked to imagine that the date originally scheduled for 8:00 p.m. had to be rescheduled and moved forward 1 hour and to indicate the new time of the date (adapted from McGlone & Harding, 1998). Participants who responded “9:00 p.m.” were coded as having an ego motion perspective while those who responded “7:00 p.m.” were coded as having a time motion perspective.

See Appendix A for a copy of the scenario, planning instructions and dependent measures.

Results

Preliminary analyses indicated that there were no significant differences across the planning conditions on any of the demographic variables (i.e., age, gender, and year of study) (*ps* > .54)[1]. To test for effects of planning direction, each dependent measure was submitted to a one-way ANOVA with planning direction as the between-subjects factor (see Table 1 for means) followed by post hoc comparisons using the LSD test.

Time Predictions

To test the primary hypothesis – that participants who engage in backward planning predict later task completion times than those who engage in forward or unspecified planning – participants’ predictions of when they would be finished getting ready for the date were examined. Each prediction was converted into a number of minutes before the 8:00 p.m. deadline. The analysis of those predictions revealed a significant effect of planning direction that supported the hypothesis, $F(2, 229) = 3.45$, $p = .03$, $\eta^2 = .03$. Post hoc comparisons indicated that participants in the backward planning condition (M = 31.01 min., SD = 23.87 min.) expected to be ready with less time to spare

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[1] Due to the nature of the target task, analyses were conducted including gender as an additional factor. A significant main effect of gender was found for the measures of predicted start time and predicted working time such that females predicted that they would start getting ready earlier ($p < .001$), and spend more time getting ready ($p < .001$) than males. However, gender was not found to interact with planning direction on predictions of completion time ($p = .33$), start time ($p = .52$), or working time ($p = .44$).

than those in the forward planning condition (*M* = 42.90, *SD* = 41.48), $p = .04$, $d = .35$, and the unspecified planning condition (*M* = 44.89, *SD* = 40.94), $p = .02$, $d = .41$. Finish time predictions made by those in the forward planning condition and the unspecified planning condition did not differ significantly, $p = .73$, $d = .06$. There were no significant effects of planning direction on participants' predictions of when they would start getting ready, $F(2, 229) = 2.31$, $p = .12$, $\eta^2 = .01$, or how long they would spend on the task, $F(2, 229) = .40$, $p = .67$, $\eta^2 = .003$.

Perceptions of the Planning Exercise

Participants' perceptions of the planning exercise were examined next. It was expected that participants who engaged in backward planning would report that the exercise led them to develop new planning insights (i.e., clarify their planning steps, think of new planning steps, break their plans down into important steps and consider potential obstacles) to a greater degree than those participants who engaged in forward or unspecified planning. Consistent with this hypothesis, the analysis of the planning insights index revealed a significant main effect of planning direction, $F(2, 229) = 6.81$, $p = .001$, $\eta^2 = .06$. Participants reported experiencing more novel planning insights in the backward planning condition (*M* = 4.42, *SD* = 1.23) than in the forward planning condition (*M* = 3.81, *SD* = 1.19), $p = .002$, $d = .51$, and in the unspecified planning condition (*M* = 3.79, *SD* = 1.22), $p = .001$, $d = .51$. Perceived insights reported by those in the forward and unspecified planning conditions did not differ significantly, $p = .92$, $d < .001$.

Planning Difficulty

There was a significant effect of planning direction on the perceived difficulty of the planning exercise, $F(2, 229) = 18.89$, $p < .001$, $\eta^2 = .14$. Participants reported that the planning exercise was a more difficult task to complete in the backward planning condition ($M = 3.94$, $SD = 1.77$) than in the forward planning condition ($M = 3.32$, $SD = 1.63$), $p = .03$, $d = .35$, and the unspecified planning condition ($M = 2.31$, $SD = 1.65$), $p < .001$, $d = .96$. Participants in the forward planning condition reported that the planning exercise was a more difficult task to complete than those in the unspecified condition, $p < .001$, $d = .63$.

Potential Obstacles

The analysis of the perceived obstacles index also revealed a significant main effect of planning direction, $F(2, 229) = 4.86$, $p = .01$, $\eta^2 = .04$. As expected, participants believed that it was more likely they would be delayed by obstacles and interruptions in the backward planning condition ($M = 4.32$, $SD = 1.15$) than in the forward planning condition ($M = 3.85$, $SD = 1.20$), $p = .01$, $d = .41$, and the control condition ($M = 3.80$, $SD = 1.10$), $p = .01$, $d = .46$. Perceived obstacles reported by those in the forward and unspecified planning conditions did not differ significantly, $p = .77$, $d = .06$.

Perceived Control

The analysis of the perceived control index did not yield a significant effect of planning direction, $F(2, 229) = 1.25$, $p = .29$, $\eta^2 = .01$. Participants reported equivalent, and moderately high perceptions of control in all planning conditions.

Time Pressure

The analysis of the time pressure index did not yield a significant effect of planning direction, $F(2, 229) = .31$, $p = .74$, $\eta^2 = .003$. Participants in all conditions reported that they did not feel under great time pressure.

Subjective Closeness

Concerning the measure of subjective closeness, the analysis did not yield a significant effect of planning direction, $F(2, 229) = .77$, $p = .47$, $\eta^2 = .007$. On average, participants indicated that the date felt somewhat far away ($M = 6.43$, $SD = 2.54$).

Motion Perspective

A Chi-Square test of association was conducted to determine if there was an effect of planning direction on motion perspective. As hypothesized, a significant effect of planning direction emerged, X^2 (2, N = 230) = 7.60, $p = .02$. Forward planners were only slightly more likely to have a time motion perspective (n = 39, 54.9%) than an ego motion perspective (n = 32, 45.1%). Similarly, those in the unspecified planning condition were slightly more likely to have a time motion perspective (n = 46, 57.5%) than an ego motion perspective (n = 34, 42.5%). However, backward planners were far more likely to have a time motion perspective (n = 59, 74.7%) than an ego motion perspective (n = 20, 25.3%).

Number of Plans

In the planning instructions, participants were asked to list their steps in point form, beginning each separate step with a dash (-) on a new line and to state “no plans” in the text box for any time intervals that they did not expect to be preparing for the date. These plans were then counted by a coder (see Table 2 for means). Although the one-way analysis did not reveal a significant effect of planning direction, $F(2, 229) = 1.92$, $p = .15$, $\eta^2 = .02$, post hoc comparisons indicated that participants in the backward planning condition ($M = 12.89$, $SD = 5.25$) wrote slightly, but not significantly, more plans than participants in the unspecified planning condition (*M* = 11.37, *SD* = 4.67), *p* = .06, *d* = .29, but not more plans than those in the forward planning condition (*M* = 11.78, *SD* = 5.20), *p* = .18, *d* = .20. The number of plans written by participants in the forward and unspecified planning direction conditions did not significantly differ, *p* = .62, *d* = .09.

Plan clustering. We were also interested in the distribution of plans across the "timeline" (i.e., from 2:00 p.m. until 8:00 p.m.) and whether or not planning direction influenced where the majority of plans clustered (i.e., near the beginning of the timeline or near the end). To examine this, the frequency of "early plans" was computed by summing the number of plans during the 2:00 p.m. – 5:00 p.m. time interval, and the frequency of "late plans" was computed by summing the number of plans from the 5:00 p.m. – 8:00 p.m. interval. Although the one-way analysis did not reveal a significant effect of planning direction on the number of plans written in the first half of the timeline, $F(2, 229) = .76$, $p = .47$, $\eta^2 = .01$, planning direction did influence the number of plans written in the latter half of the timeline, $F(2, 229) = 3.79$, $p = .02$, $\eta^2 = .03$. Post hoc comparisons indicated that participants in the backward planning condition (*M* = 9.40, *SD* = 3.76) wrote more plans in the latter half of the timeline than participants in the forward (*M* = 7.92, *SD* = 3.86), *p* = .01, *d* = .41, and unspecified (*M* = 8.13, *SD* = 3.31), *p* = .03, *d* = .35 planning conditions. The number of late plans written by participants in the forward and unspecified planning direction conditions did not significantly differ, *p* = .73, *d* = .06. See Table 2 for means.

Correlations with Time Predictions

Finally, the relations among participants' scores on the supplementary measures and their time predictions were examined. Zero order correlations are presented in Table

3. Participants' ratings on the supplementary measures generally showed very little relation to their predictions of task completion time. However, a significant correlation between perceived planning insights and time predictions emerged such that participants who reported more novel planning insights also predicted that the task would be finished later, $r(229) = -.14$, $p = .03$, and would require more time to complete, $r(229) = .13$, $p = .04$. This pattern of correlation is consistent with the hypotheses. It was also found that the correlations between planning insights and measures that displayed a similar effect of planning direction were approaching statistical significance; specifically the ratings of planning difficulty, $r(232) = .12$, $p = .08$, and potential obstacles, $r(232) = .12$, $p = .07$. Despite these relationships, however, the measure of planning insights was not found to mediate the effect of planning direction on completion time predictions (forward vs. backward CI [-8.3309, .1682]; backward vs. unspecified CI [-3.3765, 1.1413]). No other significant correlations between the supplementary measures and predictions emerged.

Concerning the correlations between the number of plans and time predictions, it was found that a greater number of written plans was associated with less optimistic finish time predictions, $r(232) = -.19$, $p = .01$. Despite this relationship, however, the number of plans participants wrote was not found to mediate the relationship between planning direction and completion time predictions (forward vs. backward CI [-3.9800, .1713]; backward vs. unspecified CI [-9.0314, .1853]). Unsurprisingly, the number of plans participants wrote was associated with greater expectations of working time, $r(232) = .20$, $p = .002$, and increased perceptions of planning insights, $r(232) = .16$, $p = .01$.

When the correlations between plan clustering and time predictions were examined, it was found that the number of late plans was associated with less optimistic completion predictions $r(232) = -.29$, $p < .001$. Further, the number of late plans was found to mediate the relationship between planning direction and completion time predictions (forward vs. backward CI [-8.7580, -.7150]; backward vs. unspecified CI [-10.3746, -.6519]). As with the total plan counts, the generation of more late plans was associated with increased perceptions of planning insights, $r(232) = .15$, $p = .02$.

Lastly, an examination of the correlations among the supplementary measures revealed several expected relationships. For example, in line with our theorizing, participants who felt that the planning exercise was a more difficult task to complete also identified more potential obstacles, felt under greater time pressure, and felt less in control. Also, the participants who expected to encounter greater obstacles also felt under greater time pressure and less in control. Further, feelings of control were associated with reduced feelings of being under time pressure and increased perceptions of subjective distance from the deadline; specifically, participants who felt in control also felt that the deadline was further away. Lastly, time pressure was associated with feelings of deadline closeness and the adoption of a time motion perspective. Although feelings of control were expected to be lower among those participants with a time motion perspective, increased feelings of being under time pressure also make sense in light of the theorizing.

Discussion

The findings support the hypothesis that backward planning – in comparison to other kinds of planning – results in longer predictions of task completion time. Participants predicted they would be ready for their date with less time to spare when they used a backward planning approach rather than forward or unspecified planning. Interestingly, this was not because their predictions were anchored around the deadline;

participants did not expect to start the task later nor did they expect that the task itself would require a greater amount of working time than forward or unspecified planners. This pattern of effects may suggest that participants in the backward planning condition made greater allowance for factors external to the task itself (e.g., unexpected interruptions and problems) to delay the ultimate completion of the task. Consistent with this interpretation, backward planners, relative to forward and unspecified planners, believed that it was more likely they would encounter obstacles, delays and interruptions. This finding is especially noteworthy in light of research by Peetz et al. (2010) who found that people are less likely to consider obstacles when planning for hypothetical (vs. real-life) projects. Participants also reported that the backward planning exercise led them to develop new insights (i.e., clarify their planning steps, think of new planning steps, and break their plans down into important steps) to a greater degree than those participants who engaged in forward and unspecified planning. Backward planners generated slightly, but non-significantly, more plans than unspecified (but not forward) planners, and these additional plans tended to fall in the latter (vs. early) half of the timeline.

Concerning process, despite the significant negative correlation between the measure of planning insights and completion time predictions, insights were not found to function as a mediator. However, the measure of late plan clustering – which was positively correlated with insights – was found to mediate the effect of planning direction on completion time predictions. It could be argued that a clustering of plans around the deadline indicates that participants were anchored to it. However, a corresponding effect of plan clustering around the beginning of the plan was not found for forward planners, thus the effect may be unique to the task itself (i.e., romantic date). Taken together, these findings provide some evidence that an increase in late stage planning and increased planning insights leads people to make less optimistic finish time predictions.

One issue with the present study is that the target task is one that might not be highly prone to the planning fallacy. People are more likely to underestimate completion times for tasks that are longer in duration (Buehler at al., 2010; Haljekelsvik & Jørgensen, 2012) than this relatively small task. Underestimation is also more likely when people are motivated to finish a task early (Buehler et al., 1997; Byram, 1997), and in this study, participants had no real motivation to finish getting ready for the date early. Thus, although planning direction was found to influence finish time predictions, it remains to be seen whether these effects generalize to other types of tasks, and in particular the kinds of tasks that may be more prone to the planning fallacy. In the next study, the target task was changed to address this issue.

Study 2

School Assignment Scenario

The main purpose of the second study was to examine the impact of planning direction on completion time predictions, but this time using a target task that would likely be more prone to the planning fallacy. To ensure that participants would be planning for a relatively important and challenging goal, participants were asked to plan for a hypothetical school assignment, where there were incentives for finishing early. Participants were again instructed to develop a plan for project completion using either a forward, backward or unspecified planning approach. After outlining their plans, participants again made several predictions and completed several supplementary measures (e.g., planning insights, potential obstacles, feelings of control, and motion perspective). The main hypothesis was that backward planners would make less optimistic finish time predictions than both forward and unspecified planners. Again, there were no specific hypotheses for the measures of predicted start time and working time. It was also hypothesized that backward planners would report greater planning insights and identify more potential obstacles while planning than both forward and unspecified planners. It was also expected that these variables may be functioning as mediators. Lastly, it was expected that backward planners would adopt a time (vs. ego) motion perspective to a greater degree than forward and unspecified planners.

Method

Participants

Initially 156 undergraduate students from Wilfrid Laurier University completed the study, however, 20 participants were excluded because they answered two attention-check items incorrectly (n = 18) or did not fully complete the planning exercise or dependent measures (n = 2). The final sample consisted of 136 undergraduate students (45 male, 89 female, 1 other identity, 1 missing data) between the ages of 17 and 41 (*M* = 19.08 years, *SD* = 2.31 years) who participated in exchange for course credit.

Procedure

The procedure was very similar to that of Study 1. Participants were again invited to complete an online questionnaire examining how people think about, plan for and make predictions regarding future events. Participants first provided demographic information including their age, gender and year in university. Participants were then asked to engage in a visualization exercise of a hypothetical event and to think about and experience the scenario as something that is real and happening to them. Participants were then presented with a scenario in which they needed to complete a major school assignment in the next two weeks. In this scenario, the participant was required to write a major paper that must be at least 12 pages long and include a minimum of eight sources with references, four of which must be from relevant journal articles that could be found only in the library. Additionally, it was noted that the assignment fell at a time of year that was usually busy for most students, and, as an incentive to have the assignment done promptly, the instructor would award an extra 2% for every day before the due date that the assignment was submitted. This incentive was included to provide participants with some motivation to complete the assignment as early as possible. The assignment was due in 14 days and had to be submitted by 11:59 p.m. on the due date[2].

Participants were then asked to develop a plan that included each and every step they would have to perform to complete the assignment. As in Study 1, participants were provided with a timeline comprised of a series of 14 text boxes spanning the period between the present date (Day 1) and the due date (Day 14). Participants were instructed to use the text boxes to list all of the steps they would need to take to complete the assignment, beginning each separate step on a new line. For any days that participants did not plan to work on the assignment, they were instructed to state “no plans” in the text box.

To manipulate the temporal direction of their planning, participants were again randomly assigned to a backward planning condition, forward planning condition, or an

[2] An additional instruction was included in an attempt to experimentally vary the perceived importance of the task. Participants were told that the assignment was either extremely important to them and worth 50% of the final class grade, or that it was not all that important to them and worth 10% of the final class grade. Analyses that included task importance as a factor produced no main effects or interactions. As such, this factor is not discussed further.

unspecified planning condition that did not specify temporal direction, using instructions adapted from the previous study.

Time predictions. The primary dependent variable was the participants' predictions of when they would finish the assignment. Participants were asked, "How many days before the due date will you finish the assignment?" and responded using a drop down menu with response options ranging from 0 days before the due date (i.e., the due date) through 14 days before the due date (i.e., today). Using the same response options, participants were also asked to predict how many days before the due date they would start the assignment, and how many hours of actual working time (i.e., time working on the assignment itself) it would take to finish the assignment.

Perceptions of planning. After generating their time predictions, participants completed a series of measures concerning their perceptions of the planning exercise and the target assignment. As in the previous study, four items assessed participants' perceptions that going through the planning exercise had resulted in novel planning insights. Participants rated the extent to which they believed that the planning exercise: "Helped me clarify the steps I would need to take to properly prepare for the assignment", "Made me think of steps that I wouldn't have thought of otherwise", "Made me break down my plans into important steps", and "Made me think of potential problems or obstacles I could encounter" using a scale from 1 *(Strongly disagree*) to 7 (*Strongly agree*). These items were averaged to form an index of perceived planning insights with higher scores indicating greater insights (α = .79, M = 4.82, SD = 1.01).

Planning difficulty. Participants also rated the extent to which they believed that the planning exercise was a difficult task to complete using a scale from 1 (*Strongly* *disagree*) to 7 (*Strongly agree*) with higher scores indicating greater perceptions of difficulty.

Potential obstacles. Participants' thoughts about potential obstacles were assessed with a single item from the previous study: Participants rated how difficult it would be to stick to their plan using a scale from 1 (*Extremely easy*) to 7 *(Extremely difficult*). The remaining items used to assess potential obstacles in the previous study were inadvertently omitted from the questionnaire.

Perceived control. The same three items were included to assess participants' perceptions of control over the task. Participants rated their agreement with the following statements: "I feel confident and in control of the situation", "I have control over how I prepare for my assignment", and "I have control over when I prepare for my assignment" using a scale from 1 (*Strongly disagree*) to 7 (*Strongly agree*). These items were averaged to form an index with higher scores indicating greater perceptions of control ($\alpha = .82$, $M = 5.58$, $SD = .93$).

Motion Perspective. To measure motion perspective, participants were asked to imagine that the due date (14 days from today) for the assignment had been moved forward two days, and to indicate how many "days from today" the assignment was now due. Participants who responded "16 days from today" were coded as having an ego motion perspective, while those who responded "12 days from today" were coded as having a time motion perspective.

See Appendix B for a copy of the scenario, planning instructions and dependent measures.

Results

Preliminary analyses indicated that there were no significant differences across the planning conditions on any of the demographic variables (i.e., age, gender, and year of study) (*ps* > .29). To test for effects of planning direction each dependent measure was submitted to a one-way ANOVA with planning direction as the between-subjects factor (see Table 4 for means) followed by post hoc comparisons using the LSD test.

Time Predictions

The analysis of task completion predictions revealed a significant effect of planning direction that again supported the hypothesis, $F(2, 133) = 3.80$, $p = .03$, $\eta^2 = .05$. Post hoc comparisons indicated that participants in the backward planning condition (M = 2.25 days, SD = 2.04 days) predicted they would complete the assignment fewer days before the deadline than those in the forward planning condition ($M = 3.44$, $SD = 2.91$), $p = .04$, $d = .46$, and the unspecified planning condition ($M = 3.79$, $SD = 3.12$), $p = .01$, $d = .59$. Finish time predictions made by those in the forward planning condition and the unspecified planning condition did not differ significantly, $p = .55$, $d = .11$. Again, there were no significant effects of planning direction on participants' predictions of when they would start getting ready, $F(2, 133) = 1.13$, $p = .33$, $\eta^2 = .02$, or how long they would spend working on the task, $F(2, 133) = .90$, $p = .41$, $\eta^2 = .01$.

Perceptions of the Planning Exercise

As in Study 1, the analysis of the planning insights index revealed a significant main effect of planning direction, $F(2, 133) = 7.74$, $p = .001$, $\eta^2 = .10$. Participants reported experiencing more novel planning insights in the backward planning condition ($M = 5.22$, $SD = .83$) than in the forward planning condition ($M = 4.44$, $SD = .99$), p <

.001, *d* = .84, and slightly, but non-significantly, more than in the unspecified planning condition (*M* = 4.87, *SD* = 1.05), *p* = .10, *d* = .35. Perceived insights reported by those in the forward and unspecified planning conditions differed significantly, *p* = .03, *d* = .41.

Planning Difficulty

Unlike the previous study, participants' ratings of the difficulty of the planning exercise did not differ significantly across planning conditions, $F(2, 133) = 1.36$, $p = .26$, $\eta^2 = .02$.

Potential Obstacles

There was again some evidence that the planning manipulation influenced the perceived likelihood of obstacles, $F(2, 133) = 1.91$, $p = .08$, $\eta^2 = .04$. Participants believed that it was more likely they would be delayed by obstacles in the backward planning condition (*M* = 3.98, *SD* = 1.45) than in the control condition (*M* = 3.31, *SD* = 1.39), *p* = .03, *d* = .46 Perceived obstacles reported by those in the backward planning condition and forward planning condition (*M* = 3.60, *SD* = 1.31) did not differ significantly, *p* = .19, *d* = .29. Perceived obstacles reported by those in the forward and unspecified planning conditions also did not differ significantly, *p* = .32, *d* = .20.

Perceived Control

As in the previous study, there were no significant differences in perceived control across the planning conditions, $F(2, 133) = .42$, $p = .66$, $\eta^2 = .01$.

Motion Perspective

A Chi-Square test of association was conducted to determine if there was an effect of planning direction on motion perspective. Although a significant relationship emerged, X^2 (2, N = 119) = 18.81, $p < .001$, the pattern of results somewhat differed from the results of Study 1 where it was found that forward planners and those in the control condition were almost equally likely to have either perspective. In Study 2, it was found that forward planners were far more likely to have an ego motion perspective (n = 28, 68.3%) than a time motion perspective (n = 13, 31.7%). Similarly, those in the unspecified planning condition were also far more likely to have an ego motion perspective (n = 28, 61.5%) than a time motion perspective (n = 13, 38.5%). However, for backward planners, it was again found that they were far more likely to have a time motion perspective (n = 30, 76.9%) than an ego motion perspective (n = 9, 23.1%). Thus the backward planning exercise appeared to induce a time motion perspective, even in a context where people were normally inclined to have the ego motion perspective.

Number of Plans

Using the 14 text boxes, participants were asked to list their steps in point form, beginning each separate step with a dash (-) on a new line. These plans were then counted by a coder (see Table 5 for means). The analysis of the total number of plans did not reveal a significant effect of planning direction, $F(2, 129) = .18$, $p = .84$, $\eta^2 = .003$.

Plan Clustering

We were also interested in the distribution of plans across the “timeline” (i.e., from Day 1 until Day 14) and whether or not planning direction influenced where the majority of plans clustered (i.e., near the beginning of the timeline or near the end). As in Study 1, an “early plan” variable was computed by summing the number of plans from the Day 1 – Day 7 time interval, and a “late plan” variable was computed by summing the number of plans from the Day 8 – Day 14 interval. The one-way analysis did not reveal a significant effect of planning direction on the number of plans written in the first half of the timeline, $F(2, 131) = .46$, $p = .63$, $\eta^2 = .01$, or the second half of the timeline, $F(2, 131) = 1.15$, $p = .32$, $\eta^2 = .02$ (see Table 5 for means).

Correlations with Time Predictions

Finally, we examined the relations between participants' scores on the supplementary measures (i.e., perceived obstacles, control, planning insights, difficulty) and their time predictions. Zero order correlations are presented in Table 6. Participants' ratings on the supplementary measures again showed little relation to their predictions of task completion time. Unlike the previous study, there was not a significant negative correlation between perceived planning insights and time predictions. However, a significant relationship between perceptions of control and task completion predictions emerged such that participants who felt more in control made more optimistic finish time predictions, $r(136) = .22$, $p = .01$. Recall, however, that planning direction did not influence perceptions of control.

Ratings of planning difficulty were negatively associated with finish time predictions such that people who rated the task as more difficult made slightly less optimistic finish time predictions, $r(136) = -.13$, $p = .13$; note however that the correlation was not significant. Ratings of planning difficulty were also negatively associated with feelings of control such that those who rated the planning exercise as more difficult also reported feeling less in control, $r(136) = -.29$, $p = .001$. Although backward planners rated the planning exercise as more difficult than forward or unspecified planners in Study 1, this effect was not found in the present study (Study 2).

Further, participants who identified more potential obstacles also made slightly, but non-significantly, fewer optimistic finish time predictions, $r(136) = -.14$, $p = .10$.

Since backward planners anticipated more potential obstacles than those in the control group but not more than those in the forward planning group, mediational analyses were performed to test whether potential obstacles mediated the effect of planning direction across the backward vs. control condition. It was found that the identification of potential obstacles mediated the effect of planning direction (backward vs. control) on predicted finish times (CI [-.96, -.02]). This finding provides some evidence that the increased perceptions of potential obstacles that backward planners are reporting are leading them to make less optimistic finish time predictions.

An examination of the inter-correlations among variables reveals many of the same patterns noted in Study 1. Increased perceptions of planning difficulty were associated with greater planning insights, the identification of more potential obstacles, and lower perceptions of control. The identification of potential obstacles was also associated with lowered perceptions of control. Further, lower perceptions of control were associated with a time motion perspective. This finding replicates existing research on feelings of control and motion perspectives which found a time motion perspective to be associated with reduced feelings of control (Boltz & Yum, 2010).

Concerning the correlations between the number of plans and time predictions, it was found that a greater number of written plans was again associated with less optimistic finish time predictions, $r(132) = -.24$, $p = .01$. Further, early plan clustering was associated with more optimistic completion predictions, $r(132) = .26$, $p = .002$, whereas late plan clustering was associated with less optimistic completion predictions, $r(132) = -.63$, $p < .001$. However, because the total number of plans, as well as the number of early and late plans, were not influenced by planning direction, tests of mediation were not performed.

Discussion

The results provided further evidence that backward planning, in comparison to forward and unspecified planning, results in less optimistic finish time predictions not only for short, simple tasks (e.g., preparing for a date), but also for more extensive tasks that are often prone to the planning fallacy (e.g., academic projects). The findings also provide further evidence that backward planning causes people to experience planning insights (i.e., clarify their planning steps, think of new planning steps, break their plans down into important steps and think of potential problems or obstacles) to a greater degree than those participants who engaged in forward planning. However, although backward planners reported experiencing more planning insights, these insights were not correlated with their finish time predictions as they were in Study 1. In fact, the only measures that strongly correlated with finish time predictions (i.e., perceived control and number of plans) were not affected by planning direction.

Additionally, backward planners did not rate the planning exercise as being more difficult than those in the forward or unspecified planning conditions as they did in Study 1. Somewhat similar to Study 1, backward planners scored higher than unspecified planners on the measure of potential obstacles, and this measure was found to mediate the effect of planning direction (i.e., backward vs. control condition) on finish time predictions. This finding provides some support for the explanation that backward planning leads people to consider potential problems and obstacles that could arise during goal pursuit which then leads them to make less optimistic finish time predictions. Lastly, the effect of planning direction on the number of written plans as well as end-stage plan clustering found in Study 1 was not replicated in Study 2. This suggests that the effect may have indeed been unique to the hypothetical dating scenario.

A limitation of the present study is that participants planned for a hypothetical scenario involving a task that they were not actually carrying out. As previously stated, an advantage of using a standard hypothetical task is that it affords a high degree of experimental control. Indeed, the expected effects of planning direction on time predictions emerged in two studies as well as some hypothesized effects on potential mediating variables (e.g., planning insights, obstacles); however, because hypothetical target tasks were utilized (and provided a strict test of our hypotheses), mediational – and other – processes may have been obscured. To address this limitation, the next two studies move beyond hypothetical task scenarios to examine the effects of backward planning on a range of consequential, real world tasks (Studies 3 and 4), and to assess the effects of planning direction on actual completion times rather than on only plans and predictions (Study 4).

Study 3

Self-nominated Tasks

The main purpose of this study was to examine the impact of planning direction on real projects that participants were actually planning on carrying out. Participants first identified a project they needed to complete within the next month that would require them to carry out many different steps across several days. Nominated projects were further classified as either academic (e.g., finishing an essay) or personal (i.e., making a slideshow of pictures for a wedding) to determine whether effects of backward planning may be moderated by the type of project. Participants were then randomly assigned to develop a detailed plan using either forward, backward or unspecified planning and then made several predictions (i.e., finish time, start time, working time) and completed several supplementary measures to assess their thoughts and perceptions. It should be noted that the planning exercise was not structured with a timeline as in previous studies. This is due to the fact that participants nominated their own projects with varying deadlines, making it impractical to provide a timeline that all participants could work with. Instead participants were provided with a single open-ended text box to list the steps of their plan.

It was hypothesized that backward planners would again make less optimistic finish time predictions than both forward and unspecified planners. Based on the findings from Studies 1 and 2, an effect of planning direction on predicted start time and working time was not expected. It was also hypothesized that backward planners would report greater planning insights and identify more potential obstacles while planning than both forward and unspecified planners. It was also expected that these variables may be functioning as mediators. Lastly, it was expected that backward planners would adopt a time (vs. ego) motion perspective to a greater degree than forward and unspecified planners.

Method

Participants

Initially 240 students from Wilfrid Laurier University were recruited for the study, however, students were excluded from the study if they nominated tasks that were not consistent with instructions: Exams or tests that could only be done at a fixed time (n

= 54), tasks with a deadline more than a month away (n = 13), and tasks with a deadline the same day as the study (n = 6). Participants were also excluded if they predicted finishing after the stated deadline (n = 17), or did not complete the main dependent measures (n = 3). The final sample consisted of 147 undergraduate students (62 male, 85 female) between the ages of 17 and 47 (*M* = 19.50 years, *SD* = 3.24 years) who participated in exchange for course credit.

Procedure

Participants were invited to complete an online questionnaire examining how individuals think about, plan for, and make predictions regarding upcoming projects. Participants first reported demographic information (i.e., age, gender and year in university) and were asked to think of a project that they would be doing in the coming month. They were told that this could be either a school project (e.g., writing a paper) or a personal project (e.g., organizing photo albums) as long as it was a major project that would involve carrying out many different steps across several days. Additionally, participants were instructed that their project must be one that: they had to complete sometime within the next month (i.e., there is a firm deadline), they were free to complete at any time before the deadline, and they were hoping to finish as soon as possible (i.e., well before the final deadline). Participants were then asked to identify their projects and describe them in a few words. Participants also reported the deadline and rated the importance of the project (1 = *Not very important*, 7 = *Very important*) and the extent to which they wished that the project could be done as soon as possible (1 = *Not at all*, 11 = *A great extent*).

Participants then completed a planning exercise that asked them to develop a plan for carrying out the project. Participants were informed that they would later be asked several questions about the project and that the purpose of the planning exercise was to help them think about when and how they would finish it. Further instructions were varied to manipulate planning direction.

Participants randomly assigned to the forward planning condition received the following instructions:

> We would like you to spend some time developing a plan or scenario for carrying out the project. Also, we want you to develop your plan in a particular way that would be called "forward planning". Forward planning involves starting with the very first step that needs to be taken and then moving onward from there to the end of the project in a chronological order. That is, you should try to picture in your mind how the project is likely to unfold –including details such as *when, where, and how it will be done* – in a forward direction. Begin by thinking of the very first step that you will need to take and how that will be accomplished, then think of the step you will need to take after that, and so on until you reach the very last step that you will be taking to complete the project.

Participants randomly assigned to the backward planning condition received the following instructions:

> We would like you to spend some time developing a plan or scenario for carrying out the project. Also, we want you to develop your plan in a way that would be called "backward planning". Backward planning involves starting with the very last step that needs to be taken to finish the project and then moving backward from there to the beginning of the project in a reverse-chronological order. That is, you should try to picture in your mind how the project is likely to unfold – including details such as *when, where, and how it will be done* – in a backward direction. Begin by thinking of the very last step that you will need to take and how that will be accomplished, then think of the step you will need to take before that, and so on until you reach the very first step that you will be taking to complete the project.

Participants in the control condition received the following instructions:

> We would like you to spend some time developing a plan or scenario for carrying out the project. That is, you should try to picture in your mind how the project is likely to unfold – including details such as when, where, and how it will be done.

All participants were provided with an open-ended text box and asked to list the steps in point form, beginning each separate step with a dash (-) on a new line. The text box was expandable, so that participants were able to list as few or as many planning steps as they wanted.

It should also be noted that this study was conducted over two academic terms and the control condition was not introduced until the second term. As a result, there are fewer participants in the control condition than in the other two conditions. Also, some supplementary measures (i.e., subjective closeness, perceived control and motion perspective) were added in the second term and thus the sample size is reduced for analyses of these measures (n = 105).

Time predictions. Participants were asked to predict their task completion time in relation to their stated deadline: How many days before the deadline do you think you will finish the project? Participants also predicted how many days before the deadline they would start working on the project, and how many hours of actual working time it would take them to finish the project. Participants then completed a thought listing question that asked them to describe how they arrived at their prediction of when the project would be finished.

Perceptions of planning exercise. As in the previous studies, four items assessed participants' perceptions that going through the planning exercise had resulted in novel planning insights. Using a scale from 1 (*Not at all*) to 11 (*Extremely*), participants rated the extent to which they believed that the planning exercise: "Helped me clarify the steps I would need to be taking for successful project completion", "Made me think of steps that I wouldn't have thought of otherwise", "Made me break down my plans into important steps", and "Made me think of potential problems or obstacles I could encounter". These items were averaged to form an index of perceived planning insights with higher scores indicating greater insights (α = .66, *M* = 7.40, *SD* = 1.57).

Planning difficulty. Participants also rated the extent to which they believed that the planning exercise was a difficult task to complete (1 = *Not at all true*, 11 = *Very true*).

Perceived control. Using a scale from 1 (*Not a lot*) to 11 (*A great deal*), a subset of the sample (n = 105) rated their agreement with the following three statements: "How much control do you have over when you will start working on the project?", "How much control do you have over when you will work on the project?", and "How much control do you have over when you will finish the project?" These three items were averaged to form an index with higher scores indicating greater perceptions of control (α = .71, *M* = 8.56, *SD* = 1.72).

Potential obstacles. Participants completed the same four items used in Study 1 to assess their beliefs about potential obstacles. Using a scale from 1 (*Not at all*) to 11 (*Extremely*), participants rated how difficult it would be to stick to the plan that they developed, and how likely it was that they would: "Need to carry out extra steps they didn't think to include in their plans", "Encounter problems when doing the project itself", and "Be delayed by interruptions or distractions from outside events (i.e., other events and activities that compete for your time)". These four items were averaged to form an index of potential obstacles with higher scores indicating a greater anticipation of obstacles during goal pursuit (α = .72, *M* = 7.11, *SD* = 1.84).

Subjective closeness. As a measure of the subjective distance of the deadline, a subset of the sample (n = 105) rated how close or far away the project deadline felt to them using a scale from 1 (*Feels like tomorrow*) to 10 (*Feels very far away*).

Motion perspective. To measure motion perspective, a subset of the sample (n = 105) were asked to imagine that a meeting originally scheduled for next week on Wednesday had been moved forward two days and to indicate the new meeting date. Participants who responded "Friday" were coded as having an ego motion perspective, while those who responded "Monday" were coded as having a time motion perspective.

See Appendix C for a copy of the instructions, planning exercise and dependent measures.

Results

Preliminary analyses indicated that there were no significant differences across the planning conditions on any of the demographic variables (i.e., age, gender, year of study, and project type) ($ps > .44$). An examination of the project descriptions indicated that about half of participants (n = 79, 53.7%) nominated academic projects (e.g., writing an essay, completing a statistics assignment) and the remaining participants (n = 68, 46.3%) nominated a variety of non-academic projects (e.g., creating a photo slideshow for a wedding, booking a vacation, moving apartments). Because these two types of projects could differ in several respects (e.g., deadline urgency, project scope, etc.) project type was included as a factor in all analyses. Each dependent measure was submitted to a 2 (project type: academic, non-academic) × 3 (planning direction: control, forward, backward) ANOVA (see Table 7 for means) followed by post hoc comparisons using the LSD test[3].

Time Predictions

The ANOVA performed on the task completion predictions revealed a significant main effect of project type such that participants who selected academic projects (M = 3.14, SD = 2.78) predicted that they would complete their projects closer to the deadline than those who selected non-academic projects (M = 4.14, SD = 3.03), $F(1, 141) = 4.01$, $p = .05$, $\eta^2 = .03$. Concerning planning direction, the hypothesized pattern of effects emerged, $F(2, 141) = 3.30$, $p = .04$, $\eta^2 = .05$. As in the previous studies, participants expected they would finish the project closer to the deadline in the backward planning condition (M = 2.80, SD = 2.19) than in the forward planning condition (M = 3.86, SD = 3.54), $p = .05$, $d = .35$, and the unspecified planning condition (M = 4.28, SD = 2.72), $p = .02$, $d = .59$. Finish time predictions made by those in the forward planning condition and the unspecified planning condition did not differ significantly, $p = .52$, $d = .13$. There was not an interaction of project type and planning direction.

As in previous studies, there was not a significant effect of planning direction on predicted start times, $F(2, 141) = 2.33$, $p = .10$, $\eta^2 = .02$, or predicted performance times, $F(2, 140) = .40$, $p = .67$, $\eta^2 = .01$. However, a significant effect of project type on predicted start times emerged. Participants who selected academic projects (M = 8.25, SD = 11.79) predicted that they would start their projects closer to the deadline than those

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[3] There was an unexpected difference across conditions in the ratings of project importance obtained prior to the planning exercise: Projects were rated as more important in the control condition (M = 8.93, SD = 2.35) than in the forward condition (M = 7.43, SD = 2.15) and backward condition (M = 7.87, SD = 2.48), $F(2, 140) = 4.05$, $p = .02$. Project importance was also positively correlated with finish time predictions such that high ratings of importance were associated with earlier predictions, $r(146) = .19$, $p = .02$. Accordingly, each of the analyses that we report was also performed including project importance as a covariate. These additional analyses revealed the same effects as the reported analyses.

who selected non-academic projects (M = 16.66, SD = 9.55), F(1, 141) = 20.55, p < .001, η^2 = .13. No significant effects of project type on predicted working time emerged.

Perceptions of Planning Exercise

The ANOVA performed on the index of planning insights did not yield a significant effect of planning direction, F(2, 141) = .09, p = .91, η^2 = .001, or project type, F(1, 141) = 3.22, p = .08, η^2 = .02. Thus, unlike the first two studies, there was no evidence that backward planners believed they experienced more planning insights than those in the other planning conditions.

Planning Difficulty

The analysis of ratings of planning difficulty did not yield a significant effect of planning direction, F(2, 141) = 1.58, p = .21, η^2 = .02, or project type, F(1, 141) = 1.04, p = .31, η^2 = .01.

Potential Obstacles

The analysis of the potential obstacles index did not yield a significant effect of planning direction, F(2, 141) = 1.16, p = .32, η^2 = .02, or project type, F(1, 141) = 1.23, p = .27, η^2 = .01.

Perceived Control

The analysis of the control index also did not yield a significant effect of planning direction, F(2, 99) = 2.14, p = .12, η^2 = .04, or project type, F(1, 99) = .06, p = .80, η^2 = .001.

Subjective Closeness

The analysis of the subjective closeness item did not yield a significant effect of planning direction, F(2, 99) = .66, p = .52, η^2 = .01. However, a significant effect of project type emerged indicating that participants who selected academic projects (*M* = 3.57, *SD* = 2.51) indicated that their deadline felt closer to the present than those who selected non-academic projects (*M* = 5.19, SD = 2.57), $F(1, 99) = 10.00$, $p = .002$, $\eta^2 = .09$.

Motion Perspective

A Chi-Square test of association was conducted to determine if there was an effect of planning direction on motion perspective. A significant relationship emerged, X^2 (2, N = 105) = 16.76, $p < .001$. Similar to Study 2, it was found that forward planners were far more likely to have an ego motion perspective (n = 21, 65.6%) than a time motion perspective (n = 11, 34.4%). Similarly, those in the unspecified planning condition were also far more likely to have an ego motion perspective (n = 19, 59.4%) than a time motion perspective (n = 13, 40.6%). However, for backward planners, it was again found that they were far more likely to have a time motion perspective (n = 32, 78%) than an ego motion perspective (n = 9, 22%).

Number of Plans

All participants were provided with an open-ended text box and asked to list the steps in point form, beginning each separate step with a dash (-) on a new line. These plans were then counted by a coder. Although the one-way analysis did not reveal an overall effect of planning direction, $F(2, 144) = 1.93$, $p = .15$, $\eta^2 = .03$, post hoc comparisons indicated that participants in the backward planning condition (*M* = 6.80, *SD* = 2.87) wrote more plans than participants in the forward planning condition (*M* = 5.73, *SD* = 3.07), $p = .05$, $d = .35$, but not more plans than those in the unspecified planning condition (*M* = 6.38, *SD* = 2.70), $p = .51$, $d = .19$. The number of plans written by participants in the forward and unspecified planning direction conditions did not significantly differ, $p = .65$, $d = .16$.

Correlations with Time Predictions

Unlike in the previous studies, finish time predictions were not significantly correlated with any other dependent measures (*ps* > .12) or the number of plans that participants wrote (*ps* > .44). However, several theorized relationships among dependent measures again emerged. For example, planning insights were positively associated with the perception of obstacles and feelings of control. Difficulty was associated with increased perceptions of obstacles. Lastly, feelings of control were again negatively associated with motion perspectives such that people in a time motion perspective reported lower feelings of control. Zero order correlations are presented in Table 8.

Discussion

The results provided evidence that backward planning, in comparison to forward and unspecified planning, results in less optimistic finish time predictions not only for hypothetical tasks, but also for important real world tasks nominated by the participants. However, despite replicating the effect of planning direction on predicted completion times, planning direction did not significantly influence any of the supplementary measures. Most notably, the effect of planning direction seen previously on measures of planning insights and potential obstacles was not obtained in this study. The absence of these effects in the present study may reflect any number of changes that were made, such as the move to a consequential target task, the increased variability created by examining a unique, idiosyncratic project for each participant, the altered format of the planning exercise, and so on, and we can only speculate as to which of these changes may be responsible. Given that the next study also examines nominated target tasks, we postpone further discussion of these findings to the general discussion. Another noteworthy limitation of the study is that it did not assess the participants' actual task completion times, and thus cannot speak to questions of prediction accuracy. Although backward planning led to predictions that were more conservative (i.e., closer to the deadline), there is no evidence that these predictions were any more accurate or unbiased than those in the other conditions. These issues are addressed in the next study.

Study 4

Self-nominated Tasks with Follow-up

The main purpose of the final study was to replicate the effects of planning direction on predicted completion times for real projects, and also to test the effects on the accuracy of task completion predictions. Thus, the procedure was similar to the previous study, but a follow-up session was included to track participants' actual completion times for the target project. As in previous research on the planning fallacy (e.g., Buehler et al., 2010; Peetz et al., 2010), this allowed us to test whether participants tended to underestimate their task completion times, and whether the backward planning strategy helped to reduce this prediction bias.

In this study, participants were asked to nominate a project that was due in the next 14 days and were instructed to plan for it using forward, backward or unspecified planning. After planning, participants were asked to make time predictions (i.e., finish time, start time and working time) and to complete the supplementary measures used in previous studies. Participants were then sent a follow-up questionnaire the day after their reported deadline where they indicated their actual task completion times. This prospective design allowed us to make comparisons between predictions and subsequent behaviour and test whether planning direction has the hypothesized influence on prediction accuracy, and also to determine whether it has an impact on how participants actually carry out the target tasks (e.g., when they start and how long they spend working on it).

It was hypothesized that backward planners would again make less optimistic finish time predictions than both forward and unspecified planners. Based on the findings from previous studies, an effect of planning direction on predicted start time and working time was not expected. It was also hypothesized that backward planners would report greater planning insights and identify more potential obstacles while planning than both forward and unspecified planners. It was also expected that these variables may be functioning as mediators. It was expected that backward planners would adopt a time (vs. ego) motion perspective to a greater degree than forward and unspecified planners. Concerning prediction accuracy, it was expected that all participants would underestimate their actual task completion times, but that backward planners will be less prone to this prediction bias than both forward and unspecified planners.

Method

Participants

Initially 196 participants were recruited online from MTurk, however participants were again excluded if they did not nominate tasks consistent with instructions (n = 6) or did not complete the planning exercise according to the instructions (n = 3). All remaining participants answered the attention check questions correctly. The final sample for the initial prediction questionnaire consisted of 187 participants (103 females, 82 males, 2 other identity) between the ages of 18 and 74 (*M* = 31.85 years, *SD* = 11.39 years). Concerning participant education levels, 27.8% completed high school, 61.5% completed college or university and 10.7% completed post-graduate studies. A follow-up questionnaire sent out the day after the reported deadline was completed by 161 (86%) of these participants, and 125 (59 male, 66 female; *M* = 32.40 years, *SD* = 11.50 years) of the participants reported that they had completed the target project. Participants were paid $.50 for completing the initial questionnaire and $1 for completing the follow-up questionnaire.

Procedure

Participants were invited to participate in a study examining how people think about, plan for and make predictions regarding future events that involved completing two online questionnaires. The initial questionnaire was similar to that of Study 3. Participants first reported demographic information (i.e., age, gender and education level) and provided an E-mail address so that they could be sent a follow-up questionnaire. Participants were then instructed to think of a project that they would be doing in the next two weeks. They were told that this could be either a school project (e.g., writing a paper), a household project (e.g., a renovation), or a personal project (e.g., organizing photo albums, filing a tax return) as long as it was a major project that would involve carrying out multiple steps across several days. Additionally, participants were instructed that their project must be one that they had to complete sometime within the next two weeks (i.e., there is a firm deadline), one they were free to complete at any time before the deadline, and one they were hoping to finish as soon as possible (i.e., well before the final deadline). Participants were then asked to identify their projects and describe them in a few words. Participants also reported the project deadline and rated the importance of the project (1 = *Not at all*, 7 = *Extremely*).

Participants then completed a planning exercise, nearly identical to the one in Study 3 that asked them to develop a detailed plan for carrying out the project. Participants were again randomly assigned to either the forward, backward or unspecified planning condition. They were provided with an open-ended text box and asked to list the steps of their plan in point form, beginning each separate step with a dash (-) on a new line. The text box was expandable, so that participants were able to list as few or as many planning steps as they wanted.

Time predictions. As in the previous studies, participants were asked "How many days before the deadline do you think you will finish the project?" Participants also predicted how many days before the deadline they would start working on the project and how many hours of actual working time it would take them to finish the project. An additional item was added in this study to assess participants' typical completion times. Specifically, participants indicated how many days before the deadline they had typically finished projects similar to the one they nominated.

Perceptions of planning exercise. As in the previous studies, four items assessed participants' perceptions that going through the planning exercise had resulted in novel planning insights. Using a scale from 1 (*Not at all*) to 7 (*Extremely*), participants rated the extent to which they believed that the planning exercise: "Helped me clarify the steps I will need to be taking for successful project completion", "Made me think of new steps that I wouldn't have thought of otherwise", "Made me break down my plans into important steps", and "Made me think of potential problems or obstacles I could encounter". These items were averaged to form an index with higher scores indicating greater insights (α = .76, *M* = 4.76, *SD* = 1.14).

Planning difficulty. The item assessing the difficulty of the planning exercise used in previous studies was inadvertently omitted from the questionnaire.

Potential obstacles. Participants completed the same four items used in Study 1 to assess their beliefs about potential obstacles. Using a scale from 1 (*Not at all*) to 7 (*Extremely*), participants rated how difficult it would be to stick to the plan that they developed, and how likely it was that they would: "Need to carry out extra steps they didn't think to include in their plans", "Encounter problems when doing the project itself", and "Be delayed by interruptions or distractions from outside events (i.e., other events and activities that compete for your time)". These four items were averaged to form an index with higher scores indicating an anticipation of obstacles during goal pursuit (α = .56, *M* = 3.99, *SD* = 1.07).

Perceived control. Using a scale from 1 (*Strongly disagree*) 7 (*Strongly agree*), participants rated their agreement with the following three statements: "I have control over how I work on my project", "I have control over when I work on my project", and "I feel confident and in control of the situation". These items were averaged to form an index with higher scores indicating greater feelings of control over their projects (α = .68, *M* = 5.84, *SD* = .94).

Time pressure. Using a scale from 1 (*Strongly disagree*) to 7 (*Strongly agree*), participants rated their agreement with the following statements: "I feel like I have a lot of time before the deadline to work on my project" (reverse-scored), "I feel like I have enough time to finish my project before the deadline" (reverse-scored), "Considering the deadline, I feel like I could use some more time to work on my project", "I feel under a lot of time pressure", and "I feel stressed about being able to finish my project on time." The items were averaged to form an index with higher scores indicating greater feelings of time pressure ($\alpha = .88$, $M = 3.00$, $SD = 1.48$).

Motion perspective. To measure motion perspective, participants were asked to imagine that a meeting originally scheduled for next week on Wednesday has been moved forward two days and to indicate the new meeting date. Participants who responded "Friday" were coded as having an ego motion perspective while those who responded "Monday" were coded as having a time motion perspective.

Follow-up questionnaire. Participants were sent an E-mail the day after their reported deadline that contained a link to the follow-up questionnaire. The E-mail also reminded participants of the project they had nominated and its deadline. Participants were asked whether they had finished the project and, if so, to report how many days before the deadline they had finished it, how many days before the deadline they had started working on it, and how many hours of actual working time they had spent on it. Participants were also asked to indicate whether they finished earlier than predicted, as predicted, or later than predicted.

See Appendix D for a copy of the instructions, planning exercise and dependent measures.

Results

Preliminary analyses indicated that there were no significant differences across the planning conditions on any of the demographic variables (i.e., age, gender, education level) or on ratings of goal importance and project type ($ps > .21$). An examination of the project descriptions indicated that the majority of participants (n = 133, 71.1%) nominated personal projects (e.g., bathroom renovation, organizing financial investments, building a table for a wedding gift, finding and moving into a new apartment), and a much smaller number of participants (n = 26, 13.9%) nominated academic projects (e.g., writing an essay, completing a take-home final exam) and work projects (n = 28, 15%) (e.g., giving a presentation, writing performance reports, training research assistants). Due to the uneven frequencies, and low number of academic projects, project type was not included as a factor in the analyses as it was in the previous study.

Analyses were performed on the full sample of participants (n = 187) to examine effects of planning direction on time predictions and on the supplementary ratings. Each dependent measure was submitted to a one-way ANOVA (planning direction: control, forward, backward) followed by post hoc comparisons using the LSD test. See Table 9 for means for the full sample. Analyses examining actual behaviour and prediction accuracy were performed on the subset of participants who reported having actually finished the target project (n = 125). For this subset of the sample, it was possible to test whether participants exhibited a systematic tendency to underestimate their actual completion times and whether the manipulation of planning direction reduced this bias. See Table 10 for means for this subset.

Time Predictions

The ANOVA performed on the task completion predictions revealed a significant main effect of planning direction, $F(2, 184) = 3.50$, $p = .03$, $\eta^2 = .04$. Again, participants expected they would finish the project closer to the deadline in the backward planning condition ($M = 2.57$, $SD = 2.57$) than in the forward planning condition ($M = 4.11$, $SD =$

3.51), $p = .01$, $d = .51$. Finish time predictions made by those in the unspecified planning condition ($M = 3.33$, $SD = 3.50$) did not significantly differ from either the forward planning condition, $p = .17$, $d = .20$, or the backward planning condition, $p = .19$, $d = .29$.

As in previous studies, predicted start times were not influenced by planning direction, $F(2, 184) = .82$, $p = .44$, $\eta^2 = .01$. However, the analysis of predicted performance times revealed an unexpected main effect of planning direction, $F(2, 184) = 4.07$, $p = .02$, $\eta^2 = .04$, indicating that participants predicted to spend more time working on the task in the control condition ($M = 24.27$, $SD = 27.56$) than in either the backward planning condition ($M = 14.85$, $SD = 18.21$), $p = .02$, $d = .41$, or forward condition ($M = 14.32$, $SD = 18.87$), $p = .01$, $d = .41$. Performance time predictions made by those in the forward planning condition and the backward planning condition did not differ significantly, $p = .89$, $d < .001$.

Prediction accuracy. ANOVAs performed on the follow-up responses revealed that there were no significant differences across the planning conditions for the reports of actual task completion times, $F(2, 122) = 1.91$, $p = .15$, $\eta^2 = .03$, start times, $F(2, 122) = .79$, $p = .46$, $\eta^2 = .01$, or performance times, $F(2, 122) = 1.70$, $p = .19$, $\eta^2 = .03$. Further, planning direction was not found to influence the degree to which participants completed their projects, X^2 (2, N = 161) = 1.87, $p = .40$. To test whether predictions were systematically biased, a series of paired t-tests were performed that compared time predictions with subsequent reports of actual behaviour. The analysis for task completion times indicated that participants predicted to finish their projects further before the deadline ($M = 3.25$, $SD = 2.99$) than they actually did finish ($M = 2.15$, $SD = 2.10$), $t(124) = 4.18$, $p < .001$. This finding is consistent with previous planning fallacy research demonstrating that people tend to underestimate task completion times (e.g., Buehler, Griffin, & Ross, 1994; Griffin & Buehler, 1999; Kruger & Evans, 2004). Participants also predicted that they would start working on the project further before deadline (M = 8.29, SD = 3.98) than they actually did start (M = 7.57, SD = 4.33), $t(124) = 2.41$, $p = .02$. Participants' predictions of the hours they would spend working on the project itself (M = 17.39, SD = 21.94) did not differ from the subsequent reports of actual performance times (M = 17.31, SD = 16.84), $t(124) = .05$, $p = .96$.

Was the degree of bias in the predictions of task completion time affected by the manipulation of planning direction? To answer this question, difference scores were computed that represented the discrepancy between predicted and actual completion times, with greater negative values indicating a greater underestimation bias. The analysis of these difference scores revealed a significant effect of planning direction on prediction bias, $F(2, 122) = 4.10$, $p = .02$, $\eta^2 = .06$, indicating that predictions in the backward planning condition (M = -.18, SD = 2.60) were less biased than those in the forward condition (M = -1.93, SD = 3.29), $p = .005$, $d = .29$, and slightly, but non-significantly, less biased than those in the control condition (M = -1.21, SD = 2.62), $p = .10$, $d = .41$. Bias scores did not differ significantly between the forward planning condition and unspecified planning condition, $p = .26$, $d = .11$. There was not a significant effect of planning direction on the degree of bias in predicted start times $F(2, 122) = .001$, p = 1.00, or predicted performance times, $F(2, 122) = 1.69$, $p = .20$. Further, the difference between predicted and actual completion times was significant in the forward planning condition (M = 1.93, $t(42) = 3.85$, $p < .001$) and control condition (M = 1.21, $t(37) = 2.85$, $p = .01$), but not significant in the backward planning condition (M = .46, $t(43) = .46$, p =

.65). Additionally, planning direction influenced how likely it was that participants completed their project by the time that they predicted. In particular, backward planners were more likely to complete their projects by the time they predicted than forward – but not unspecified – planners, X^2 (2, N = 125) = 6.93, *p* = .03, providing further evidence that backward planners were making more realistic predictions. In sum, engaging in backward planning reduced the general tendency to underestimate task completion times.

As an alternative test of the effect of planning direction on prediction bias, an ANCOVA was performed on predicted completion times controlling for actual completion times. Again, a significant main effect of planning direction emerged, $F(2, 121) = 3.09$, $p = .05$, $\eta^2 = .04$. Controlling for actual completion times, participants predicted finishing closer to the deadline in the backward planning condition ($M = 2.81$, $SD = 2.63$) than in the forward planning condition ($M = 3.91$, $SD = 3.27$), $p = .01$, $d = .51$. Predictions did not significantly differ between the control condition ($M = 3.00$, $SD = 3.00$) and either the backward planning condition, $p = .28$, $d = .29$, or the forward planning condition, $p = .19$, $d = .29$. There was not a significant effect of planning direction on the degree of bias in predicted start times $F(2, 121) = .28$, $p = .76$, $d = .01$, or predicted performance times, $F(2, 121) = 2.03$, $p = .14$, $d = .02$.

In addition to examining the degree of bias in prediction, the degree to which predictions were correlated with actual outcomes was examined. Predictions were quite strongly correlated with subsequent behaviour, for task completion times $r(125) = .38$, $p < .001$, task start times $r(125) = .68$, $p < .001$, and task performance times, $r(125) = .57$, $p < .001$. Also an examination of these relationships within each condition revealed a similar degree of correlation. For example, predictions of task completion time were significantly correlated with actual completion times in the backward ($r(44) = .48$, $p = .001$) and control conditions ($r(38) = .49$, $p < .001$). The correlation between predictions and actual completion times in the forward condition ($r(43) = .29$, $p = .06$) was approaching significance. Thus, whereas backward planning appeared to reduce the degree of systematic bias in predicted completion times, there was no evidence that it increased correlational accuracy. See Table 11 for correlations between predictions and actual times within each condition.

Perceptions of Planning Exercise

The ANOVA performed on the index of planning insights indicated that the main effect of planning direction was not significant, $F(2, 184) = 2.17$, $p = .12$, $\eta^2 = .02$, however an examination of subsequent LSD contrasts revealed that participants again reported significantly greater planning insights in the backward planning condition ($M = 5.00$, $SD = 1.29$) than in the forward planning condition ($M = 4.59$, $SD = 1.02$), $p = .04$, $d = .35$. The control condition ($M = 4.70$, $SD = 1.07$) did not significantly differ from either the backward planning condition, $p = .14$, $d = .29$, or the forward planning condition, $p = .57$, $d = .11$. Thus, there was again some evidence, as in the first two studies, that participants experienced greater planning insights when they engaged in backward planning rather than forward planning.

Potential Obstacles

The analysis of the potential obstacles index did not yield a significant effect of planning direction, $F(2, 184) = .88$, $p = .42$, $\eta^2 = .01$.

Perceived Control

The analysis of the control index also did not yield a significant effect of planning direction, $F(2, 183) = .01$, $p = .99$, $\eta^2 < .001$.

Time Pressure

The analysis of the time pressure index also did not yield a significant effect of planning direction, $F(2, 183) = .94$, $p = .39$, $\eta^2 = .01$.

Motion Perspective

A Chi-Square test of association was conducted to determine if there was a relationship between planning direction and motion perspective. Unlike previous studies, no significant relationship emerged, X^2 (2, N = 184) = .38, $p = .83$.

Number of Plans

All participants were provided with an open-ended text box and asked to list the steps in point form, beginning each separate step with a dash (-) on a new line. These plans were then counted by a coder. The analysis of the total number of plans did not reveal a significant effect of planning direction, $F(2, 184) = 1.36$, $p = .26$, $\eta^2 = .02$. Furthermore, the number of plans that participants wrote was not found to be significantly correlated with predicted and actual times, or any supplementary measures. See Table 10 for means.

Correlations among dependent variables: Predictions. Concerning finish time predictions, it was found that greater feelings of control were associated with more optimistic predictions, $r(186) = .17$, $p = .02$. Also, increased feelings of time pressure were associated with less optimistic finish time predictions, $r(186) = -.18$, $p = .01$, and the measures of control and time pressure were significantly and negatively correlated, $r(186) = -.50$, $p < .001$. Despite these relationships, these variables were not influenced by planning direction. Further, for the first time, the measure of motion perspective was correlated with finish time predictions such that, as expected, those in an ego motion perspective made more optimistic predictions, $r(184) = .15$, $p = .05$. However, unlike the previous three studies, motion perspective was not affected by planning direction.

When the correlations between the supplementary measures and prediction bias were examined, it was found that the correlation between finish time bias and planning insights was approaching significance in the hypothesized direction, $r(125) = -.14$, $p = .12$, such that greater planning insights were associated with less biased predictions (see Table 12 for correlations). As previously stated, backward planners were found to be significantly less biased than forward planners (but not less biased than unspecified planners, $p = .10$). Since backward planners were found to be significantly less biased than forward planners (but not less biased than unspecified planners, $p = .10$) and reported more planning insights than forward – but not unspecified – planners, mediational analyses were performed for exploratory purposes. It was found that the perception of planning insights mediated the effect of planning direction (backward vs. forward) on prediction bias (CI [-1.05, -.02]). Overall, this finding provides some evidence that the increased perceptions of insights that backward planners reported had some influence on the accuracy of their predictions.

Concerning correlations among the dependent measures, as in Study 3, it was found that greater planning insights were positively associated with the identification of potential obstacles, $r(187) = .15$, $p = .04$, and greater perceptions of control, $r(186) = .26$, $p < .001$. It was also found that greater planning insights were slightly, but non-significantly, associated with feelings of reduced time pressure, $r(186) = -.13$, $p = .08$. As in Studies 1 and 2, a greater anticipation of obstacles was associated with lower feelings of control, $r(186) = -.17$, $p = .02$, and increased feelings of being under pressure, $r(186) = .38$, $p < .001$. Zero order correlations are presented in Table 13.

Discussion

The results support the hypothesis that backward planning – in comparison to other kinds of planning (e.g., forward, unspecified) – results in longer predictions of task completion time. This effect has been shown consistently across four studies. Again, no effect of planning direction on start time predictions was found; however, there was an effect on working time predictions that was not seen in previous studies. Specifically, participants predicted to spend more time working on the task in the control condition than in either the backward or forward conditions.

As in Studies 1 and 2, the effect of planning direction on planning insights re-emerged with backward planners reporting more planning insights than forward – but not unspecified – planners. However, the measure of planning insights was not found to mediate the effects on prediction. Further, the relationships between planning direction and the measure of obstacles found in studies 1 and 2 were not replicated. Unexpectedly, the effect of planning direction on motion perspectives found in the previous studies was not replicated in Study 4. One possible explanation concerns the phrasing of the question, and is discussed in detail in the general discussion. Concerning prediction accuracy, it was found that backward planners were more accurate than forward planners (and slightly, but not significantly more accurate than unspecified planners, $p = .10$), and further, this effect of planning direction on prediction accuracy was mediated by planning insights. Overall, this finding provides further evidence that the increased insights that backward planners are reporting are leading participants to make less biased predictions.

General Discussion

Taken together, the findings of the present work (see Table 14 for a summary of findings across all studies) suggest that backward planning is a useful strategy for reducing underestimation – and bias – in task completion predictions. Four studies were conducted that experimentally varied the manner in which participants planned for a range of hypothetical and real-world tasks. The tasks varied widely in terms of type, importance, complexity and scope, and thus allowed us to test the generalizability of the effects. The main hypothesis was that backward planners would predict later task completion times than both forward planners and planners in an unspecified planning control group. This hypothesis was supported in all studies, although in Study 4 it received only partial support, as backward planners made less optimistic predictions than forward but not unspecified planners. Further, the overall effect sizes for the difference between the planning conditions on predicted finish times were moderate across the studies suggesting some practical significance (Wolf, 1986). Concerning actual completion times for complex, real-world tasks (Study 4), planning direction was not found to have an effect on when participants actually finished their tasks and projects. As expected, participants exhibited the planning fallacy to some degree; however, backward planners were found to be less biased in their completion predictions than forward (but not unspecified) planners. Thus, there is evidence that backward planning led participants to make more realistic completion predictions. In addition to the effects of backward planning on prediction and bias, the strategy was found to influence various thoughts and cognitions, some related to prediction. These findings are not only important for understanding potential mechanisms underlying the effects of backward planning, but also because they provide insights into the phenomenological experience of planning for a future event in a backward direction.

Mechanisms and the Experience of Backward Planning

Planning insights. It was theorized that backward planning would disrupt people's natural tendency towards schematic planning which would lead planners to experience greater planning insights and identify potential obstacles to a greater degree than both forward and unspecified planners. This hypothesis received some support. Backward planners reported greater insights than both forward and unspecified planners in Study 1, and in Study 2 the same pattern of results for the measure of planning insights emerged though less robust; backward planners reported greater perceptions of planning insights than forward – but not unspecified – planners. The overall effect sizes for the difference between the planning conditions on perceptions of planning insights ranged from moderate to large across the studies suggesting some practical significance (Wolf, 1986). The reported effects of planning direction on prediction and reported insights were somewhat surprising considering the hypothetical nature of the task; tasks that participants were likely not very motivated to complete (Buehler et al., 1997; Byram, 1997). Concerning the real-world tasks nominated by participants in Study 3, this hypothesis was not supported; backward planners did not report greater planning insights than those in the other conditions. However, the effect reappeared in Study 4 where backward planners again reported having greater perceptions of planning insights than forward – but not unspecified – planners. Moreover, the perception of planning insights mediated the effect of planning direction (i.e., backward vs. forward) on prediction bias, providing some evidence that the increased perceptions of insights that backward planners reported were having some influence on prediction accuracy.

Obstacles. Concerning the measure of potential obstacles, the hypothesis was supported by Studies 1 and 2. Backward planners identified more potential obstacles than forward and unspecified planners in Study 1, and indicated that it would be more difficult to stick to their plans than unspecified (but not forward) planners in Study 2. The overall effect sizes for the differences between the planning conditions on the measure of obstacles were moderate across the studies suggesting some practical significance (Wolf, 1986). Further, it was found that the measure of obstacles mediated the effect of planning direction (i.e., backward vs. unspecified) on predicted finish times in Study 2. This finding provides some evidence that the increased perceptions of potential obstacles that backward planners reported led them to make less optimistic finish time predictions. Moreover, in Studies 3 and 4, the measure of planning insights was found to be significantly positively correlated with measures of obstacles. Thus, backward planning appears to be exacting some influence on prediction via these variables.

Number of plans. There was some evidence that participants in the backward planning condition wrote slightly, but non-significantly, more plans than participants in the unspecified (Study 1) and forward (Study 3) planning conditions. Furthermore, it was found that for backward planners in Study 1, plans tended to cluster in the latter half of the timeline. Although late plan clustering was positively correlated with planning insights and found to mediate the relationship between planning direction and completion time predictions, this effect was not replicated in Study 2, and not tested in Studies 3 and

4 due to the less structured format of the planning exercise. A clustering of plans around the deadline (Study 1) could suggest that participants were anchored to it. However, a corresponding effect of plan clustering around the beginning of the plan was not found for forward planners. Furthermore, for reasons that will be outlined below, a plausible explanation for the clustering of plans would be that backward planners were experiencing greater planning insights which led them to identify more last-minute steps than their forward and unspecified counterparts. However, because this effect was not replicated in Study 2, it could be unique to the sample or the task itself (i.e., romantic date).

Anchoring effects. It was argued that that effects of backward planning on predicted completion times would be created by the planning process itself – working through the individual steps needed to carry out a task – rather than by simple anchoring effects. As expected, differences in completion predictions created by backward planning were not accompanied by an equivalent effect on predicted start times. It was not the case that predictions made by those in the backward planning condition were shifted toward the deadline, as would be expected if the effects were due to deadline anchoring. Moreover, several hypothesized effects of backward planning on various measures (e.g., planning insights, obstacles) were found, as well as some evidence of mediation. This suggests that the effect of planning direction on completion predictions may be attributable to the thoughts and cognitions elicited by the strategy rather than a simple anchoring effect.

Motion perspectives. Lastly, it was expected that backward planners would adopt a time (vs. ego) motion perspective to a greater degree than forward and unspecified planners. In Study 1, it was found that both forward and unspecified planners were slightly more likely to have a time motion perspective than an ego motion perspective. However, as hypothesized, backward planners were far more likely to have a time motion perspective than an ego motion perspective. Furthermore, in Studies 2 and 3, it was found that forward and unspecified planners were far more likely to have an ego motion perspective than a time motion perspective. However, for backward planners, it was found that they were far more likely to have a time motion perspective than an ego motion perspective. Unexpectedly, this pattern of results was not found in Study 4. One possible explanation for the lack of effect concerns the wording of the question. In Study 3, participants were asked "Imagine that a meeting originally scheduled for next week on Wednesday has been moved forward two days. What day is the meeting now?" whereas in Study 4, participants were asked "Please imagine the following scenario. A meeting originally scheduled for next Wednesday has been moved forward 2 days. What day is the meeting now?" The key phrase "Imagine that a meeting originally scheduled for next week on Wednesday" was inadvertently omitted from the Study 4 question. Consequently, the question might have been confusing for participants completing the survey on a Monday or a Tuesday. In particular, if participants interpreted the question as meaning Wednesday of this week, then responding "Monday" would imply that the meeting would be moved into the past. Indeed, data was collected from 83% of the sample on a Tuesday ($n = 155$), thus it is plausible that the wording of this question may account for the lack of effect in Study 4.

Despite this, the finding that backward planning influenced participants' experiences and conceptualizations of time is interesting in itself. Specifically, backward planners were more likely to adopt a time motion perspective; that is, experience time as flowing towards them from the future. Past research has found a time motion perspective to be related to reduced feelings of control (Boltz & Yum, 2010), and indeed, a time motion perspective was associated with increased feelings of time pressure (Study 1), and decreased perceptions of control (Studies 2-4). Interestingly, backward planners adopted a time motion perspective to a greater degree and made later completion time predictions without reporting reduced feelings of control. This suggests that although backward planning induces a mindset that typically leads to reduced feelings of control, the strategy may help people experience (or reframe) the impending flow of time as something less threatening. Perhaps the insights elicited by backward planning are instead experienced as a type of forethought, which leads people to feel prepared and energized – rather than overwhelmed – by them. Backward planning could function in much the same way as an altered visual perspective (Buehler et al., 2012) allowing people to see things – and in this case, experience time – in a different manner. This explanation would also support the claim that backward planning helps people see their target task and associated plans from a new perspective (Rutherford, 2008).

Supplementary measures. With regard to the remaining supplementary measures, the hypothesized relationships between planning direction and these variables received mixed support across the studies. Backward planners rated the planning exercise as more difficult than forward and unspecified planners only in Study 1, which suggests that effects on prediction are not likely due to the difficulty of the planning exercise (Sanna et al., 2009; Schwarz, 2004; Schwarz et al., 1991). Further, although there was some evidence that backward planners wrote more plans than forward and unspecified planners, they did not perceive the planning task as more difficult; in fact, ratings of plan difficulty were never found to be significantly correlated with the number of written plans (Studies 1-3, not measured in Study 4). Thus, because backward planners were able to generate extra plans with relative ease, it appears that effects on prediction may have more to do with plan content and associated cognitions rather than the difficulty of planning.

In addition, the expected relationships between planning direction and measures of control, time pressure and subjective closeness were not supported. In light of the effects on motion perspective (and the documented relationships between motion perspective and these variables), this lack of effect suggests that prediction effects are mostly related to the measures of perceived planning insights, the identification of potential obstacles, or some other unmeasured factor. This finding is interesting in light of research that has found mixed results for a focus on obstacles; some studies have found that a focus reduces the planning fallacy (Peetz et al., 2010) whereas other studies have found no effect (Newby-Clark et al., 2000). Buehler and Griffin (2014) speculated that people are motivated to discount potential problems and obstacles which is why they are rarely integrated into their plans (Krizan & Windschitl, 2007; Kunda, 1990). However, in the case of backward planning, perhaps the insights gleaned from the new perspective lead participants to experience a focus on problems and obstacles prompted by the strategy in a different manner; instead of regarding problems and obstacles as threatening things that must be discounted, they may be experienced as products of forethought that must be planned for instead. Backward planning may get people thinking in a different way that allows the identification of problems and obstacles to surface in a more organic and non-threatening manner. This "ownership" of insights and plans may explain why backward planners noted increased perceptions of problems and obstacles with no corresponding reduction in perceptions of control. The present research provides further evidence that at least a partial focus on potential problems and obstacles could be useful in reducing the planning fallacy.

Theoretical Contributions, Practical Implications, and Future Directions

The main theoretical reasoning behind the effects of backward planning on prediction is that, through a reversal of temporal direction, the strategy disrupts the schemas and scripts that people typically rely on when generating plans and making subsequent predictions (Anderson, 1990; Bartlett, 1932; Tse et al., 2007). Despite the fact that this is difficult to demonstrate, there is some evidence that backward planners are planning less schematically. First, the measure of planning insights asks whether the planning exercise led participants to "think of new steps" – something that could be indicative of non-schematic planning – and indeed, backward planners scored higher on this measure than those in the other conditions. Second, because references to problems and obstacles tend to be absent from highly idealized and schematic plans for the future (Buehler et al., 1994; Newby-Clark et al., 2000), the fact that backward planners reported them to a greater degree suggests that they are breaking away from schemas. Attempts were made at coding participant plans for problems and obstacles, but due to the nature of the planning exercise, it was difficult to develop a reliable coding scheme. Specifically, we did not explicitly ask participants to think of problems and obstacles as in previous research (Buehler et al., 1994; Newby-Clark et al., 2000), and thus they could not be easily coded. Instead, participant plans only alluded to problems and obstacles; for example, the plan “I will have a nap” could be indicative of an identification of the potential future problem of being tired during the date, but because the planner did not explicitly identify this as a problem, it could not be coded as such. Future research could have participants first make plans in either a forward, backward or unspecified way, but have them code their planning steps in some way, or write down “why” they planned what they planned. Participant instructions could also be altered to explicitly ask them to list problems and obstacles after planning. Perhaps backward planners would list more of these than forward planners. Taken together, these results extend previous work done on backward recall (Geiselman & Callot, 1990) to future contexts, and provide further evidence in support of the schema-disrupting effect of a cognitive reversal of temporal direction.

It is also true that backward planning may affect processes that are difficult to measure. Comparable to motion perspectives (Boroditsky, 2000; Clark, 1973), the effects of a reversal in temporal direction when planning may be a process not easily captured by standard self-reports of insights or the anticipation of problems and obstacles. When travelling through time from the future to the present while planning, participants may have thoughts about problems and obstacles, and base their plans on those insights, but their plans may only allude to these thoughts, and they may be largely unaware of this process when asked after the fact. In this sense, the insights prompted by backward planning could be experienced as little flickers of intuition as one develops their plans; mentally noted, and integrated accordingly. When asked about the experience of planning, one might have a sense that, indeed, they were having more insights and identifying more problems and obstacles; but these perceptions would only be approximations of the real process of travelling through plans in a backward direction and all its cognitive nuances. In this sense, perhaps the true mechanism is too embedded in the manipulation to be adequately parsed out by the standard methods used in these studies. Future research could employ different qualitative methodologies to better explore process. For example, planning could occur during an audio taped interview; while the participant walked through plans for some upcoming task in a backward direction, the interviewer would be able to ask questions concerning certain planning steps in order to identify intention. For example, in the case of the participant who planned to “have a nap”, an interviewer could probe further and identify the reasoning behind this planning step.

With the aim of further elucidating mechanism, future research could examine the effects of the backward planning process on actual goal pursuit. Specifically, although the measure of planning insights was not found to reliably mediate the effect of planning direction on completion predictions, as expected, it was negatively correlated with finish time predictions in Studies 1, 2, and bias in Study 4. Further, participants consistently indicated that backward (vs. forward, unspecified) planning led them to clarify their planning steps, think of new steps, break plans down into important steps, and consider potential problems and obstacles when planning, suggesting that the strategy is having a significant and positive impact on how people are thinking about their goals, plans and deadlines. It is conceivable that our measure of planning insights is mirroring very real qualitative changes in plan content that may align more closely with actual goal pursuit. In this manner, plans generated in a backward direction may be more comprehensive and realistic, allowing people to complete individual planning steps on time and as planned.

Greater correspondence between plans and goal progress could then in turn influence the qualitative experience of goal pursuit (e.g., increased motivation, increased confidence, increased agency, and decreased stress). Future research could examine how well progress corresponds with plans generated in a backward direction, and how this may influence the affective experience of goal pursuit.

Concerning practical implications, although backward planning is used to forecast the time courses of large-scale projects (Bagheri & Hjorth, 2007; Dreborg, 1996; Dreborg et al., 1999; Hall, 1976; Holmberg, 1998), the target tasks and projects we examined were comparatively small and temporally close; that is, the average deadline was 6 hours away in Study 1, 14 days away in Study 2, 14.91 days away in Study 3, and 10.76 days away in Study 4. In light of research examining a focus on problems and obstacles and temporal distance (Peetz et al., 2010), backward planning could be a particularly useful strategy for planning for both close and distant goals. Future research could examine temporal distance as an additional factor by asking participants to generate plans for long-term goals, such as career or retirement savings plans. Further, our planning instructions differed from those typically used in business and project management contexts that focus planners on critical start and finish times for complex projects (Lewis, 2002; Verzuh, 2005). Instead, our planning exercise instructions more closely resembled task unpacking (Hadjichristidis et al., 2014; Kruger & Evans, 2004; Rottenstreich & Tversky, 1997) as this was more appropriate for the kinds of personal tasks and projects we were targeting. As a result, we were able to provide some support for the anecdotal claims made about the strategy by those in applied contexts. Specifically, we found evidence that backward planning led people to clarify their plans (Saintamour, 2008), plan more realistically (Fleming, 2010), anticipate obstacles (The Ball Foundation, 2007), better manage their time, and see their target task and associated plans from a new perspective (Rutherford, 2008). Future research could explore different forms of backward planning (e.g., critical start and finish time planning) to see if some forms are better suited to certain types of goals and timeframes than others.

Concluding Remarks

To conclude, through four studies, we experimentally varied the manner in which participants planned for a variety of hypothetical and real-world tasks. Specifically, the studies examined the effect of backward planning on predictions for a hypothetical dating scenario (Study 1), a hypothetical school assignment (Study 2), and various real-life, self-nominated goals (Study 3 and 4). Study 4 assessed both predicted and actual completion times, and thus provided a test of whether people generally underestimated their completion times, and whether backward planning reduced this underestimation bias. We utilized both student (Studies 1-3) and adult samples (Study 4) and tasks that varied widely in terms of type, importance, complexity and scope. Through the four studies, we reliably identified an effect of backward planning on prediction and prediction bias; however, despite hints of evidence for mediational processes, and interesting relationships among variables, we were not able to definitively identify a mechanism underlying these effects. Despite this shortcoming, the findings of the present work suggest that planning for an upcoming task in a backward direction helps individuals generate more realistic completion time predictions. We also provide some evidence that this effect is accompanied by perceptions of novel planning insights and an increased focus on potential problems and obstacles elicited by the strategy.

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Table 1
Dependent Variables by Planning Direction (Study 1)

		Control	Forward	Backward
Predicted finish time	M	44.89	42.90	31.01
	SD	40.94	41.48	22.87
Predicted start time	M	184.31	179.79	157.44
	SD	82.96	85.54	74.33
Predicted working time	M	129.96	136.22	125.53
	SD	66.88	75.86	78.36
Planning insights	M	3.79	3.81	4.42
	SD	1.22	1.19	1.23
Planning difficulty	M	2.31	3.32	3.94
	SD	1.65	1.63	1.77
Potential obstacles	M	3.80	3.85	4.32
	SD	1.10	1.20	1.15
Perceived control	M	6.10	5.89	5.88
	SD	1.00	.97	.94
Time pressure	M	1.78	1.90	1.87
	SD	.99	1.03	1.03
Subjective closeness	M	6.69	6.18	6.39
	SD	2.67	2.24	2.66
	n	80	72	80

Note: Predicted finish time and predicted start time are expressed in *minutes before deadline*. Predicted working time is expressed in *minutes*.

Table 2
Number of Plans by Planning Direction (Study 1)

Time Interval		Control	Forward	Backward
2:00	M	.58	.54	.59
	SD	.81	.65	.67
2:30	M	.51	.61	.59
	SD	.86	.93	.72
3:00	M	.52	.67	.54
	SD	.66	.81	.62
3:30	M	.40	.69	.56
	SD	.65	.71	.57
4:00	M	.60	.67	.62
	SD	.82	.75	.70
4:30	M	.64	.68	.59
	SD	.83	.67	.63
5:00	M	.70	.75	.80
	SD	.64	.65	.64
5:30	M	.86	.93	.84
	SD	.81	1.30	.68
6:00	M	1.25	1.00	1.14
	SD	1.05	.87	.81
6:30	M	1.34	1.18	1.57
	SD	1.14	.88	1.24
7:00	M	1.40	1.50	1.75
	SD	1.01	1.14	1.11
7:30	M	1.49	1.29	1.84
	SD	1.04	.91	1.32
8:00	M	1.09	1.26	1.46
	SD	.43	1.05	1.23
Total plans	M	11.37	11.78	12.89
	SD	4.67	5.20	5.25
Early plans	M	3.25	3.86	3.49
	SD	2.96	3.32	2.90

Late plans	M	8.13	7.92	9.40
	SD	3.31	3.86	3.76
	n	80	72	80

Table 3

Correlations among Dependent Variables (Study 1)

	Start time	Working time	Insights	Difficulty	Obstacles	Control	Time pressure	Closeness	Mot. Persp.	No. Plans
Finish time	.28**	-.07	-.14*	.04	.02	.06	-.02	-.01	.08	-.19**
Start time		.52**	.05	.09	.05	-.07	.12	-.11	.07	-.01
Working time			.13*	.08	.06	-.04	.11	-.10	.01	.20**
Insights				.12	.12	.00	.07	-.10	.11	.16*
Difficulty					.41**	-.27**	.24**	-.01	.01	-.03
Obstacles						-.28**	.24**	-.03	-.07	.01
Control							.55**	.31**	-.01	.02
Time pressure								-.26**	-.13*	.04
Closeness									.03	-.04
Mot. Persp.										-.08

*$p < .05$

**$p < .01$

Table 4

Dependent Variables by Planning Direction (Study 2)

		Control	Forward	Backward
Predicted finish time	M	3.79	3.44	2.25
	SD	3.11	2.91	2.04
Predicted start time	M	13.02	12.26	11.84
	SD	3.38	3.80	3.88
Predicted working time	M	24.08	17.83	21.22
	SD	26.61	20.41	20.15
Planning insights	M	4.87	4.44	5.22
	SD	1.05	1.00	.83
Planning difficulty	M	3.43	2.96	3.11
	SD	1.50	1.23	1.40
Potential obstacles	M	3.31	3.60	3.98
	SD	1.39	1.31	1.45
Perceived control	M	5.69	5.53	5.54
	SD	.74	.89	1.11
	n	42	50	44

Note: Predicted finish time and predicted start time are expressed in *days before deadline*. Predicted working time is expressed in *hours*.

Table 5
Number of Plans by Planning Direction (Study 2)

Day		Control	Forward	Backward
1	M	1.29	1.50	1.23
	SD	1.00	.97	.83
2	M	1.40	1.30	1.10
	SD	1.06	.97	.74
3	M	1.52	1.24	1.20
	SD	1.11	.96	1.07
4	M	1.12	1.34	1.20
	SD	1.09	.90	.79
5	M	1.21	.96	1.08
	SD	.98	.67	.62
6	M	1.00	1.00	1.10
	SD	.99	.76	.63
7	M	1.31	1.16	1.13
	SD	1.22	.96	.61
8	M	1.00	1.14	1.15
	SD	.66	1.11	.92
9	M	.98	.90	1.05
	SD	.90	.81	.68
10	M	.90	.84	1.15
	SD	.79	.68	.80
11	M	1.19	.72	.98
	SD	1.50	.78	.77
12	M	.81	.64	.90
	SD	1.02	.72	.90
13	M	.50	.78	.78
	SD	.86	1.46	.92
14	M	.36	.64	.78
	SD	.69	.96	.86

Day		Control	Forward	Backward
Total Plans	M	14.60	14.16	14.80
	SD	5.77	4.56	5.40
Early plans	M	8.86	8.50	7.95
	SD	5.19	3.89	3.97
Late plans	M	5.74	5.66	6.78
	SD	3.87	3.81	3.58
	n	42	50	40

Table 6

Correlations among Dependent Variables (Study 2)

	Start time	Working time	Insights	Difficulty	Obstacles	Control	Mot. Persp.	No. Plans
Finish time	.39**	.06	-.04	-.13	-.14	.22**	.01	-.24**
Start time		.15	.09	.01	-.00	.13	.12	.22**
Working time			.03	-.02	-.07	-.07	.11	.12
Insights				.23**	.03	.11	-.06	-.04
Difficulty					.15	-.20*	.01	.10
Obstacles						-.29**	.04	-.05
Control							-.21*	.01
Mot. Persp.								-.08

*$p < .05$

**$p < .01$

Table 7
Dependent Variables by Planning Direction (Study 3)

		Control	Forward	Backward
Predicted finish time	M	4.28	3.86	2.80
	SD	2.72	3.54	2.19
	n	32	56	59
Predicted start time	M	15.11	12.26	10.00
	SD	13.72	10.39	11.00
	n	32	56	59
Predicted working time	M	11.30	13.97	13.71
	SD	13.72	14.33	13.75
	n	32	56	57
Planning insights	M	7.47	7.57	7.43
	SD	1.99	1.80	1.46
	n	32	56	59
Planning difficulty	M	4.20	4.63	5.19
	SD	2.68	2.60	2.53
	n	32	56	59
Potential obstacles	M	6.74	7.36	7.07
	SD	2.24	1.80	1.61
	n	32	56	59
Perceived control	M	9.06	8.19	8.43
	SD	1.43	1.93	1.70
	n	32	32	41
Subjective closeness	M	4.49	3.98	4.66
	SD	2.67	2.66	2.65
	n	32	32	41

Note: Predicted finish time and predicted start time are expressed in *days before deadline*. Predicted working time is expressed in *hours*.

Table 8

Correlations among Dependent Variables (Study 3)

	Start time	Working time	Insights	Difficulty	Obstacles	Control	Closeness	Motion persp.	No. Plans
Finish time	.45**	.23**	.07	-.02	-.01	-.10	.15	-.08	-.07
Start time		.41**	.18*	.01	.04	-.01	.29**	-.06	-.05
Working time			.15	.07	.20*	.04	-.09	-.16	.12
Insights				-.03	.25**	.29**	.02	-.02	.21**
Difficulty					.20*	-.12	-.06	.10	-.15
Obstacles						.01	-.11	-.03	.10
Control							-.24*	-.20*	.24*
Closeness								.04	-.05
Motion persp.									-.19*

*$p < .05$

**$p < .01$

Table 9

Dependent Variables by Planning Direction in Full Sample (N = 187) (Study 4)

		Control	Forward	Backward
Predicted finish time	M	3.33	4.11	2.57
	SD	3.50	3.51	2.57
Predicted start time	M	9.42	8.82	8.52
	SD	4.29	3.82	3.90
Predicted working time	M	24.27	14.32	14.85
	SD	27.56	18.87	18.21
Planning insights	M	4.70	4.59	5.00
	SD	1.07	1.02	1.29
Potential obstacles	M	3.96	3.84	4.10
	SD	1.33	.98	.94
Perceived control	M	5.84	5.84	5.83
	SD	.90	.95	.98
Time pressure	M	3.21	2.93	2.87
	SD	1.57	1.34	1.52
	n	64	62	61

Note: Predicted finish time and predicted start time are expressed in *days before deadline*. Predicted working time is expressed in *hours*.

Table 10
Dependent Variables by Planning Direction in Sample with Completed Projects (n = 125) (Study 4)

		Control	Forward	Backward
Predicted finish time	M	3.00	3.91	2.82
	SD	3.00	3.27	2.63
Actual finish time	M	1.79	1.98	2.64
	SD	1.79	1.93	2.44
Bias	M	-1.21	-1.93	-.18
	SD	2.62	3.29	2.60
Predicted start time	M	8.71	8.61	7.61
	SD	4.34	3.80	3.82
Actual start time	M	7.97	7.88	6.91
	SD	4.88	3.99	4.18
Bias	M	-.74	-.72	-.71
	SD	3.32	3.81	2.92
Predicted working time	M	24.08	14.21	14.73
	SD	26.84	17.37	20.42
Actual working time	M	20.53	18.05	13.82
	SD	19.12	14.40	16.70
Bias	M	-3.55	3.84	-.91
	SD	21.04	13.79	19.93
Planning insights	M	4.75	4.63	5.10
	SD	1.04	.91	1.32
Potential obstacles	M	3.59	3.81	3.92
	SD	1.21	.97	.91
Perceived control	M	5.94	5.83	6.05
	SD	.87	1.03	.91
Time pressure	M	2.84	3.00	2.37
	SD	1.42	1.40	1.22
Number of plans	M	7.30	6.26	6.90
	SD	3.27	3.01	4.28
	n	38	43	44

Table 11

Within Condition Correlations between Predictions and Actual Times in Sample with Completed Projects (n=125) (Study 4)

	Control	Forward	Backward
Finish time	.49**	.29*	.48**
Start time	.75**	.52**	.74**
Working time	.63**	.64**	.44**

*p < .05

**p < .01

Table 12
Correlations among Dependent Variables in Sample with Completed Projects (n = 125) (Study 4)

	Finish time		
	Predicted	Actual	Bias
Actual	.39**		
Bias	-.75**	.33**	
Insights	-.10	-.06	-.14
Obstacles	-.05	.08	.11
Control	.13	.01	-.13
Pressure	-.32**	-.17	.20*
Motion perspective	.01	.04	.01

	Start time		
	Predicted	Actual	Bias
Actual	.68**		
Bias	-.31**	.49**	
Insights	.00	-.11	-.15
Obstacles	.23**	.17	-.06
Control	.01	.01	-.01
Pressure	-.00	.05	.07
Motion perspective	-.05	-.04	.00

	Working time		
	Predicted	Actual	Bias
Actual	.34**		
Bias	.04	.23**	
Insights	-.01	-.12	-.10
Obstacles	.04	.10	-.05
Control	-.03	-.06	-.01
Time pressure	.14	.13	-.05
Motion perspective	.05	-.09	-.14

*$p < .05$
**$p < .01$

Table 13
Correlations among Dependent Variables in Full Sample (N = 187) (Study 4)

	Start time	Working time	Insights	Obstacles	Control	Pressure	Motion Perspective	No. plans
Predicted finish time	.10	-.03	.03	-.05	.17*	-.18*	.15*	-.13
Predicted start time		.32**	-.02	.24**	-.01	.13	.03	-.07
Predicted working time			-.08	.04	-.12	.17*	.05	-.04
Insights				.15*	.26**	-.13	.14	.13
Obstacles					-.17*	.38**	.02	.11
Control						-.50**	-.05	-.03
Time pressure							.03	-.10
Motion perspective								.01

*$p < .05$
**$p < .01$

Table 14

Effect of Planning (Backward vs. Forward) on Dependent Measures (Studies 1-4)

Measures	Study 1		Study 2		Study 3		Study 4
Finish time	*p* = .04		*p* = .04		*p* = .05		*p* = .01
Start time	*ns*		*ns*		*ns*		*ns*
Working time	*ns*		*ns*		*ns*		*ns*
Insights	*p* = .002		*p* < .001		*ns*		*p* = .04[3]
Difficulty	*p* = .03		*ns*		*ns*		N/A
Obstacles	*p* = .01		*ns*[2]		*ns*		*ns*
Control	*ns*		*ns*		*ns*		*ns*
Time pressure	*ns*		N/A		N/A		*ns*
Closeness	*ns*		N/A		*ns*		N/A
Motion	B	74.7%	B	76.9%	B	78.0%	
perspective	F	54.9%	F	31.7%	F	34.4%	*ns*
(% time motion)	C	57.5%	C	38.5%	C	40.6%	
Number of plans	*ns*		*ns*		*p* = .05		*ns*
Early plans	*ns*		*ns*		N/A		N/A
Late plans	*p* = .01[1]		*ns*		N/A		N/A

[1] Late plan clustering mediated the effect of direction (backward vs. forward; backward vs. control) on predicted finish times.
[2] Obstacles mediated the effect of direction (backward vs. control) on predicted finish times.
[3] Planning insights mediated the effect of direction (backward vs. forward) on prediction bias.

Appendix A: Study 1 Materials

Scenario

For this study, we would like you to engage in a visualization exercise of a hypothetical (imaginary) event. This means that for the duration of the study, you should try to think about and experience the scenario as something that is real and happening to you.

Imagine that you were studying in a coffee shop one day when an extremely attractive person sat down at the table next to yours. The two of you made eye contact for a brief second. Feeling the blood rush hotly to your face, you averted your eyes and looked back down to your book. You found it hard to concentrate because you kept wanting to look up and catch another glimpse of the person. When you could stand it no longer, you finally looked up and saw that the person was looking directly at you and smiling. The person then casually got up and came over to sit at your table. After a wonderful conversation of about thirty minutes, the two of you decided that it would be an excellent idea to meet again Saturday night. You suggested "Silver Creek," a very fancy restaurant. You also told the person that the night would be your treat and offered to pick them up. After agreeing to 8:00PM, the person waved goodbye and walked out of the coffee shop (Kruger & Evans, 2004).

Planning Instructions

Now, imagine that it is 2:00 p.m. on Saturday. You have no plans for the afternoon except getting ready for your date at 8:00 p.m.

Unspecified planning condition (control)

At this time, we would like you to list each and every step you would have to do to get ready for the date in as much detail as possible. That is, you should try to picture in your mind the steps you will work through in order to reach your goal (i.e., getting ready for your date). Keeping your goal in mind, we would like you to use the timeline below to think carefully and imagine the main steps that you intend to use to reach your goal. Please work through the timeline listing all of your steps for each interval of time.

2:00 p.m. [text box]
2:30 p.m. [text box]
⋮
8:00 p.m. [text box]

Forward planning condition

At this time, we would like you to list each and every step you would have to do to get ready for the date in as much detail as possible. Also, we want you to develop your plan in a particular way called forward planning. Forward planning involves starting with the very first step that needs to be taken and then moving onward from there to the end in a chronological order. That is, you should try to picture in your mind the steps you will work through in order to reach your goal (i.e., getting ready for your date) in a forward direction. Keeping your goal in mind, we would like you to use the timeline below to think carefully and imagine the main steps that you intend to use to reach your goal in a forward direction. Please work through the timeline listing all of your steps for each interval of time in a forward, chronological direction.

2:00 p.m. [text box]
2:30 p.m. [text box]
⋮
8:00 p.m. [text box]

Backward planning condition

At this time, we would like you to list each and every step you would have to do to get ready for the date in as much detail as possible. Also, we want you to develop your plan in a particular way called backward planning. Backward planning involves starting with the very last step that needs to be taken and then moving backward from there to the beginning in a reverse-chronological order. That is, you should try to picture in your mind the steps you will work through in order to reach your goal (i.e., getting ready for your date) in a backward direction. Keeping your goal in mind, we would like you to use the timeline below to think carefully and imagine the main steps that you intend to use to reach your goal in a backward direction. Please work through the timeline listing all of your steps for each interval of time in a backward, reverse-chronological direction.

8:00 p.m. [text box]
7:30 p.m. [text box]
⋮
2:00 p.m. [text box]

Dependent Measures

Predictions

Finish time: At what time would you be ready for the date? (_ _ : _ _ PM)
Start time: At what time would you start getting ready for the date? (_ _ : _ _ PM)
Working time: How long would it take you to get ready for the date? (__ hours)

Planning insights

1. Going through this planning exercise helped me clarify the steps I would need to take to properly prepare for a date. (1 = *Strongly disagree* – 7 = *Strongly agree*)
2. Going through this planning exercise made me think of steps that I wouldn't have thought of otherwise. (1 = *Strongly disagree* – 7 = *Strongly agree*)
3. Going through this planning exercise made me break down my plans into important steps.

(1 = *Strongly disagree* – 7 = *Strongly agree*)
4. Going through this planning exercise made me think of potential problems or obstacles I could encounter. (1 = *Strongly disagree* – 7 = *Strongly agree*)

Difficulty

1. Going through this planning exercise was a difficult task to complete. (1 = *Strongly disagree* – 7 = *Strongly agree*)

Obstacles

1. In preparing for the date, how difficult would it be to stick to the step-by-step plan that you developed? (1 = *Not at all*, 7 = *Extremely*)
2. In preparing for the date, how likely is it that you would need to carry out extra steps that you didn't think to include in your plan? (1 = *Not at all*, 7 = *Extremely*)
3. In preparing for the date, how likely is it that you would encounter problems when preparing? (1 = *Not at all*, 7 = *Extremely*)
4. In preparing for the date, how likely is it that you would be delayed by interruptions or distractions from outside events (i.e., other events and activities that would compete for your time)? (1 = *Not at all*, 7 = *Extremely*)

Control

1. I feel confident and in control of the situation. (1 = *Strongly disagree* – 7 = *Strongly agree*)
2. I have control over how I prepare for my date. (1 = *Strongly disagree* – 7 = *Strongly agree*)
3. I have control over when I prepare for my date. (1 = *Strongly disagree* – 7 = *Strongly agree*)

Time pressure

1. I feel like I have a lot of time before the date. (R) (1 = *Strongly disagree* – 7 = *Strongly agree*)
2. I feel like I have enough time to prepare for the date. (R) (1 = *Strongly disagree* – 7 = *Strongly agree*)
3. I feel like I could use some more time to prepare for the date. (1 = *Strongly disagree* – 7 = *Strongly agree*)
4. I feel under a lot of time pressure. (1 = *Strongly disagree* – 7 = *Strongly agree*)
5. I feel stressed about being able to get ready in time. (1 = *Strongly disagree* – 7 = *Strongly agree*)

Subjective closeness

1. The date feels… (1 = *Very close* – 10 = *Very far away*)

Motion perspective

1. Imagine that the date has to be rescheduled. The date originally scheduled for 8:00 p.m. has been moved forward 1 hour. What time is the date now? (_ _ : _ _ PM)

Appendix B: Study 2 Materials

Scenario

For this study, we would like you to engage in a visualization exercise of a hypothetical (imaginary) event. This means that for the duration of the study, you should try to think about and experience the scenario as something that is real and happening to you.

Imagine that you have been given an assignment for one of your classes that is extremely important to you – worth 50% of your final grade. Your professor lets the class know that the assignment must be at least twelve pages with a minimum of eight sources that must be referenced. Four of these sources must be from relevant journal articles that are found *only* in the library. Your professor warns the class that the due date falls in a time that is usually busy for most students. In the past, most students finish right around the time of the deadline. As an incentive to hand it in early, the professor tells the class that he will award a bonus 2% for each day that the assignment is handed in before the deadline. Your professor announces the topic that you will have to write about today. You have two weeks from today to complete the assignment (i.e. the due date is 14 days from today). You must submit the assignment online by 11:59 p.m. on the due date.

Planning Instructions

Unspecified planning condition (control)

Now we would like you to list each and every step you would have to do to complete the assignment in as much detail as possible. That is, you should try to picture in your mind the steps you will work through in order to reach your goal (i.e. completing the assignment).

Keeping your goal in mind, we would like you to use the timeline below to think carefully and imagine the main steps that you intend to use to reach your goal. Please work through the timeline listing all of your steps for each day. If you have more than one step for that day, begin each separate step with a dash (–) on a new line. If you do not have any steps to list on a certain day, just type "no plans". The textboxes will expand.

Day 1 (Today) [text box]
Day 2 [text box]
⋮
Day 13 [text box]
Day 14 (Deadline – the assignment is due at 11:59 p.m. tonight) [text box]

Forward planning condition

Now we would like you to list each and every step you would have to do to complete the assignment in as much detail as possible. Also, we want you to develop your plan in a particular way called forward planning. Forward planning involves starting with the very first step that needs to be taken and then moving onward from there to the end in a chronological order. That is, you should try to picture in your mind the steps you will work through in order to reach your goal (i.e. completing the assignment) in a forward direction.

Keeping your goal in mind, we would like you to use the timeline below to think carefully and imagine the main steps that you intend to use to reach your goal in a forward direction. Please work through the timeline listing all your steps for each day in a forward, chronological direction. If you have more than one step for that day, begin each separate step with a dash (–) on a new line. If you do not have any steps to list on a certain day, just type “no plans”. The textboxes will expand.

Day 1 (Today) [text box]
Day 2 [text box]
⋮
Day 13 [text box]
Day 14 (Deadline – the assignment is due at 11:59 p.m. tonight) [text box]

Backward planning condition

Now we would like you to list each and every step you would have to do to complete the assignment in as much detail as possible. Also, we want you to develop your plan in a particular way called backward planning. Backward planning involves starting with the very last step that needs to be taken and then moving backward from there to the beginning in a reverse-chronological order. That is, you should try to picture in your mind the steps you will work through in order to reach your goal (i.e. completing the assignment) in a backward direction.

Keeping your goal in mind, we would like you to use the timeline below to think carefully and imagine the main steps that you intend to use to reach your goal in a backward direction. Please work through the timeline listing all of your steps for each day in a backward, reverse-chronological direction. If you have more than one step for that day, begin each separate step with a dash (–) on a new line. If you do not have any steps to list on a certain day, just type “no plans”. The textboxes will expand.

Day 14 (Deadline – the assignment is due at 11:59 p.m. tonight) [text box]
Day 13 [text box]
⋮
Day 2 [text box]
Day 1 (Today) [text box]

Dependent Measures

Predictions

Finish time: How many days before the due date will you finish the assignment? (0 days before [i.e., on the due date], 1 day before, 2 days before … 14 days before [i.e., today])
Start time: How soon before the due date will you start the assignment? (0 days before [i.e., on the due date], 1 day before, 2 days before … 14 days before [i.e., today])
Working time: How many hours of actual working time (i.e. time working on the assignment itself) do you think it will take you to finish the assignment? (__ hours)

Planning insights

1. Going through this planning exercise helped me clarify the steps I would need to take to properly prepare for the assignment. (1 = *Strongly disagree* – 7 = *Strongly agree*)
2. Going through this planning exercise made me think of steps that I wouldn't have thought of otherwise. (1 = *Strongly disagree* – 7 = *Strongly agree*)
3. Going through this planning exercise made me break down my plans into important steps. (1 = *Strongly disagree* – 7 = *Strongly agree*)
4. Going through this planning exercise made me think of potential problems or obstacles I could encounter. (1 = *Strongly disagree* – 7 = *Strongly agree*)

Difficulty

1. Going through this planning exercise was a difficult task to complete. (1 = *Strongly disagree* – 7 = *Strongly agree*)

Obstacles

1. How difficult or easy do you think it will be to follow your step by step plan? (1 = *Extremely easy* – 7 = *Extremely difficult*)

Control

1. I feel confident and in control of the situation. (1 = *Strongly disagree* – 7 = *Strongly agree*)
2. I have control over how I prepare for my assignment. (1 = *Strongly disagree* – 7 = *Strongly agree*)
3. I have control over when I prepare for my assignment. (1 = *Strongly disagree* – 7 = *Strongly agree*)

Motion perspective

1. Imagine that the due date (14 days from today) for the assignment has been moved forward two days. How many days from today is the assignment now due? Please provide a numerical answer (in days) [text box]

Appendix C: Study 3 Materials

Instructions

For this study, we would like you to think of a particular type of task or project that you will be doing in the future. This should be a project that (a) you are required to complete sometime within the next month (i.e., there is a firm deadline), (b) you are free to complete at any time before the deadline, and (c) you are hoping to finish as soon as possible (i.e., ideally you would like to finish well before the final deadline). The project should also be a fairly major one that involves carrying out many different steps across several days. For example, you could consider a major school project (e.g., writing a paper) or a personal project (e.g., organizing your photo albums), as long as it is one that must be done in the next month.

1. Please identify the project and describe it in a few words. [text box]
2. The final deadline for completing the project is: MM/DD/YYYY
3. How important is this project to you? (1 = *Not very important* – 11 = *Very important*)
4. To what extent do you wish that the project could be done as soon as possible (i.e., the sooner the better)? (1 = *Not at all* – 11 = *A great extent*)

Planning Instructions

Unspecified planning condition (control)

We would like you to spend some time developing a plan or scenario for carrying out the project. That is, you should try to picture in your mind how the project is likely to unfold – including details such as when, where, and how it will be done. Please use the space below to describe your plans. Keep in mind that the purpose of the planning exercise is to help you think about the project in a way that allows you to predict when you will be finished and to allocate your time accordingly.

List the steps in point form, beginning each separate step with a dash (–) on a new line.

[text box]

Forward planning condition

We would like you to spend some time developing a plan or scenario for carrying out the project. Also, we want you to develop your plan in a particular way that would be called “forward planning”. Forward planning involves starting with the very first step that needs to be taken and then moving onward from there to the end of the project in a chronological order. That is, you should try to picture in your mind how the project is likely to unfold –including details such as *when, where, and how it will be done* – in a forward direction. Begin by thinking of the very first step that you will need to take and how that will be accomplished, then think of the step you will need to take after that, and so on until you reach the very last step that you will be taking to complete the project.

Please use the space below to describe your plans, step-by-step, using the forward planning approach. Begin by describing the first step that you will need to take ("The very first thing I will do is…"), and then describe the step you will be taking after that ("Next I will…"), the step you will be taking after that ("Next I will…"), and so on until you reach the very last step that you will take. Keep in mind that the purpose of the planning exercise is to help you think about the project in a way that allows you to predict when you will be finished and to allocate your time accordingly.

List the steps in point form, beginning each separate step with a dash (–) on a new line.

The very first thing I will do is... [text box]

Backward planning condition

We would like you to spend some time developing a plan or scenario for carrying out the project. Also, we want you to develop your plan in a way that would be called "backward planning". Backward planning involves starting with the very last step that needs to be taken to finish the project and then moving backward from there to the beginning of the project in a reverse- chronological order. That is, you should try to picture in your mind how the project is likely to unfold –including details such as *when, where, and how it will be done* – in a backward direction. Begin by thinking of the very last step that you will need to take and how that will be accomplished, then think of the step you will need to take before that, and so on until you reach the very first step that you will be taking to complete the project.

Please use the space below to describe your plans, step-by-step, using the backward planning approach. Begin by describing the final step that you will need to take ("The very last thing I will do is…"), and then describe the step you will be taking before that ("Before that I will…"), the step you will be taking before that "(Before that I will…"), and so on until you reach the very first step that you will take. Keep in mind that the purpose of the planning exercise is to help you think about the project in a way that allows you to predict when you will be finished and to allocate your time accordingly.

List the steps in point form, beginning each separate step with a dash (–) on a new line.

The very last thing I will do is... [text box]

Dependent Measures

Predictions

Finish time: How many days before the deadline do you think you will finish the project? [text box]
Start time: How many days before the project deadline do you think you will actually start

working on the project? [text box]
Working time: How many hours of actual working time (i.e. time working on the assignment itself) do you think it will take you to finish the assignment? (__ hours)

Planning insights

1. Going through my plans in this way helped me clarify the steps I will need to be taking for successful project completion. (1 = *Strongly disagree*, 11 = *Strongly agree*)
2. Going through this planning exercise made me think of steps that I wouldn't have thought of otherwise. (1 = *Strongly disagree*, 11 = *Strongly agree*)
3. Going through this planning exercise made me break down my plans into important steps. (1 = *Strongly disagree*, 11 = *Strongly agree*)
4. Going through this planning exercise made me think of potential problems or obstacles I could encounter. (1 = *Strongly disagree*, 11 = *Strongly agree*)

Difficulty

1. Going through my plans in this way was a difficult exercise. (1 = *Not at all true* – 11 = *Very true*)

Obstacles

1. How likely is it that you will be delayed by interruptions or distractions from outside events (i.e., other events and activities that compete for your time)? (1 = *Extremely unlikely* – 11 = *Extremely likely*)
2. How likely is it that you will need to carry out extra steps that you didn't think to include in your plan? (1 = *Extremely unlikely* – 11 = *Extremely likely*)
3. How likely is it that you will encounter problems when doing the project itself? (1 = *Extremely unlikely* – 11 = *Extremely likely*)
4. How likely is it that you will be delayed by interruptions or distractions from outside events (i.e., other events and activities that compete for your time)? (1 = *Extremely unlikely* – 11 = *Extremely likely*)

Control

1. How much control do you have over when you will start working on the project? (1 = *Not a lot*, 11 = *A great deal*)
2. How much control do you have over when you will work on the project? (1 = *Not a lot*, 11 = *A great deal*)
3. How much control do you have over when you will finish the project? (1 = *Not a lot*, 11 = *A great deal*)

Subjective closeness
1. The deadline feels… (1 = *Feels like tomorrow* – 10 = *Feels very far away*)

Motion perspective

1. Imagine that a meeting originally scheduled for next week on Wednesday has been moved forward two days. What day is the meeting now?

Appendix D: Study 4 Materials

Instructions

For this study, we would like you to think of a particular type of task or project that you will be doing in the future. This should be a project that fits the follow criteria: (a) You are required to complete it sometime in the next 2 weeks (i.e., there is a firm deadline), (b) you are free to complete at any time before the deadline, and (c) You are hoping to finish as soon as possible (i.e., ideally you would like to finish well before the final deadline). The project should also be a fairly major one that involves carrying out multiple steps across several days. For example, you could consider a major school project (e.g., writing a paper), a household project (e.g., a renovation, organizing a room) or a personal project (e.g., organizing photo albums, filing a tax return), as long as it is one that must be done within the next 2 weeks.

1. Please identify the project and describe it in a few words. [text box]
2. The final deadline for completing the project is: MM/DD/YYYY
3. How important is this project to you? (1 = *Not at all* – 7 = *Extremely*)

Planning Instructions

Unspecified planning condition (control)

The rest of the questionnaire will ask you several questions about the project that you have identified, including when you think it will actually be finished. With this purpose in mind, we would like you to spend some time developing a detailed plan or scenario for carrying out the project. That is, you should imagine your plan as if it were a 'recipe' and write down every single step that you will need to follow in order to reach your project goal. That is, you should try to picture in your mind how the project is likely to unfold – including details such as *when*, *where*, and *how* it will be done.

Please use the space below to describe your plans, step-by-step. Keep in mind that the purpose of the planning exercise is to help you think about the project in a way that allows you to predict when you will be finished and to allocate your time accordingly.

List the steps in point form, beginning each separate step with a dash (–) on a new line.

[text box]

Forward planning condition

The rest of the questionnaire will ask you several questions about the project that you have identified, including when you think it will actually be finished. With this purpose in mind, we would like you to spend some time developing a detailed plan or scenario for carrying out the project. That is, you should imagine your plan as if it were a 'recipe' and write down every single step that you will need to follow in order to reach your project goal. Also, we want you to develop your plan in a particular way called “forward planning”.

Forward planning involves starting with the very first step that needs to be taken and then moving onward from there to the end of the project in a chronological order. That is, you should try to picture in your mind how the project is likely to unfold – including details such as *when*, *where*, and *how* it will be done – in a forward direction. Please use the space below to describe your plans, step-by-step, using the forward planning approach. Begin by describing the first step that you will need to take (“*The very first thing I will do is…*”), and then describe the step you will be taking after that (“*Next I will…*”), the step you will be taking after that (“*Next I will…*”), and so on until you reach the very last step that you will take. Keep in mind that the purpose of the planning exercise is to help you think about the project in a way that allows you to predict when you will be finished and to allocate your time accordingly.

List the steps in point form, beginning each separate step with a dash (–) on a new line.

The very first thing I will do is... [text box]

Backward planning condition

The rest of the questionnaire will ask you several questions about the project that you have identified, including when you think it will actually be finished. With this purpose in mind, we would like you to spend some time developing a detailed plan or scenario for carrying out the project. That is, you should imagine your plan as if it were a 'recipe' and write down every single step that you will need to follow in order to reach your project goal. Also, we want you to develop your plan in a particular way called “backward planning”.

Backward planning involves starting with the very last step that needs to be taken and then moving backward from there to the beginning of the project in a reverse-chronological order. That is, you should try to picture in your mind how the project is likely to unfold – including details such as *when*, *where*, and *how* it will be done – in a backward direction. Please use the space below to describe your plans, step-by-step, using the backward planning approach. Begin by describing the last step that you will need to take (“*The very last thing I will do is…*”), and then describe the step you will be taking before that (“*Before that I will…*”), the step you will be taking before that (“*Before that I will…*”), and so on until you reach the very first step that you will take. Keep in mind that the purpose of the planning exercise is to help you think about the project in a way that allows you to predict when you will be finished and to allocate your time accordingly.

List the steps in point form, beginning each separate step with a dash (–) on a new line.

The very last thing I will do is... [text box]

Dependent Measures

Predictions

Finish time: How many days before the deadline do you think you will finish the project? (0 days before [on the deadline), 1 day before … 14 days before)
Start time: How many days before the deadline do you think you will start working on the project? (0 days before [on the deadline), 1 day before … 14 days before)
Working time: How many hours of actual working time (i.e., time spent working on the project itself) do you think you will spend working on this project? (__ hours)

Planning insights

1. Going through my plans in this way helped me clarify the steps I will need to be taking for successful project completion. (1 = *Strongly disagree* – 7 = *Strongly agree*)
2. Going through my plans in this way made me think of new steps that I wouldn't have thought of otherwise. (1 = *Strongly disagree* – 7 = *Strongly agree*)
3. Going through my plans in this way made me break down my plans into important steps. (1 = *Strongly disagree* – 7 = *Strongly agree*)
4. Going through this planning exercise made me think of potential problems or obstacles I could encounter. (1 = *Strongly disagree* – 7 = *Strongly agree*)

Obstacles

1. How difficult or easy will it be to stick to the step by step plan that you developed? (1 = *Extremely unlikely* – 7 = *Extremely likely*)
2. How likely is it that you will encounter problems when doing the project itself? (1 = *Extremely unlikely* – 7 = *Extremely likely*)
3. How likely is it that you will need to carry out extra steps that you didn't think to include in your plan? (1 = *Extremely unlikely* – 7 = *Extremely likely*)
4. How likely is it that you will be delayed by interruptions or distractions from outside events (i.e., other events and activities that compete for your time)? (1 = *Extremely unlikely* – 7 = *Extremely likely*)

Control

1. I feel confident and in control of the situation. (1 = *Strongly disagree* – 7 = *Strongly agree*)
2. I have control over how I prepare for my date. (1 = *Strongly disagree* – 7 = *Strongly agree*)
3. I have control over when I prepare for my date. (1 = *Strongly disagree* – 7 = *Strongly agree*)

Time pressure

1. I feel like I have a lot of time before the deadline to work on my project. (R) (1 =

Strongly disagree – 7 = *Strongly agree*)
2. I feel like I have enough time to finish my project before the deadline. (R) (1 = *Strongly disagree* – 7 = *Strongly agree*)
3. Considering the deadline, I feel like I could use some more time to work on my project. (1 = *Strongly disagree* – 7 = *Strongly agree*)
4. I feel under a lot of time pressure. (1 = *Strongly disagree* – 7 = *Strongly agree*)
5. I feel stressed about being able to finish my project on time. (1 = *Strongly disagree* – 7 = *Strongly agree*)

Motion perspective

1. Please imagine the following scenario. A meeting originally scheduled for next Wednesday has been moved forward 2 days. What day is the meeting now?