Designing for Future Behaviors: Understanding the Effect of Temporal Distance on Planned Behaviors

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ABSTRACT
Despite the prevalence of theories and interventions related to behavior change, our knowledge on how intention for a target, or planned behavior, changes over time remains limited. This hinders our ability to consider the temporal aspect in our designs to support behavior change. To understand the effect of temporal distances on planned behaviors, we conducted two studies, building on the Theory of Planned Behavior and Constual Level Theory. We found that attitude about the target is more salient the further away the event, as people focus on the *why* of a behavior. On the other hand, perceived behavior control can influence intention in both near and far future. When the target is in the near future, people generally focus on the feasibility, or the *how* of the behavior. In the far future, people may also consider factors related to behavior control, if they are motivated to do so (i.e., hold a strong attitude towards the action). Findings help advance the Theory of Planned Behavior and offer strategies for designers and event organizers to motivate planned behaviors that are in the near and far future.

Author Keywords
behavior change; Theory of Planned Behavior; temporal distance; time perspective; future behaviors

INTRODUCTION
Persuasive technologies, or "interactive computing systems designed to change people's attitudes or behaviors [18]", continue to be significant area of research in HCI [23]. It could include motivating more physical activity for health [47], improving users' engagement and motivation for games [38], or encouraging users to contribute more to online communities [28,42]. To design effective persuasive technologies, many designs draw upon theories on behavior change to understand what factors influence people's behavior change decisions [16,22,30,39]. One of the most well-known and used is the Theory of Planned Behavior (TPB)[2]. TPB posits that behavior intention is the immediate antecedent to behaviors, and that intention is guided by three components: attitude, subjective norm, and perceived behavioral control [4]. TPB suggests that interventions should target those behavioral, normative, and/or control beliefs to produce positive intentions, and therefore to change behaviors [4]. For examples, in application, behavioral belief has been used to increase physical activity [10], normative belief to reduce HIV sexual risk behaviors [25] and control belief to motivate to quit smoking [6].

However, many of the target behaviors that designers need to encourage are not immediate, but rather in the future. For example, designers build a notification system that encourages users to change food-logging behavior everyday [7], or to start online courses one month after their registeration [44]. But even though someone says they will perform a planned behavior in the future, they will not necessarily do so. People's intentions change with time—we can all recount times when we said we would do something, but decided against it when the time came. Despite the wealth of studies and applications, TPB has not been extended to factor in temporal distances. In fact, meta-analyses of TPB have shown that the predictive power of the theory is significantly reduced when used to model far future behaviors [12,35]. This greatly limitis our ability to support behavior change targets that are in the future.

One obvious explanation for why using TPB to predict future behaviors breaks down is that the temporal distance lowers our ability to accurately judge the future. We may have a fairly good sense of where we are, what we are doing, what we like, who our friends are, and what our environment will be like one hour from now, but we become much more uncertain as we are asked to make those assessments further into the future. As the temporal distance increases, there is a greater chance that unforeseeable events will take place, thus changing our intentions to perform a behavior. This would, unfortunately, imply that the change in intention is random, which would be hard for designers to account for as there are no strategies that they may reliably use.

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However, existing research has shown that at least part of the change in intention is systematic. For example, research on the planning fallacy has shown that people generally tend to overcommit to events in the future [8]. Research on temporal discounting also shows how different biases affect our estimation of events or outcomes in different temporal distances, and demonstrates that we tend to overvalue immediate outcomes [19]. More recent research on Construal Level Theory (CLT) [54] integrating both these sets of prior work, states that temporal distance systematically changes people's mental representations of the future, and therefore affects their perceptions of future behaviors. CLT posits that people tend to think about behaviors in the far future more abstractly (using high level construals), while they think about behaviors in the near more concretely (using low level construals) [52].

In a behavior change context, this would mean that when the target behavior is far away, people are more focused on the *why* of an action (high level construals). But as the time approaches, people start focusing more on the *how* of an action (low level construals). The change in salience of these factors suggest that we can and should offer different designs to more effectively nudge behaviors, depending on the temporal distance. But to provide more concrete design guidelines, what is critically missing is a better understanding of how these concepts fit into the common strategies as afforded by TPB. Is attitude about the target more salient in the far future as it is more related to the why? Is perceived behavior control more salient in the near future, as it is more related to the how? How should we change our intenventions as the temporal distance changes?

To study the role of temporal distance in planned behaviors, we conducted two studies. In Study 1, we conducted a within-subjects field experiment with 30 participants to examine how intention to attend a free yoga class changes over the period of a month. We found that, supporting prior work [8,12,36,45], people's intention to perform a behavior lowers as the temporal distance decreases. At the same time, advancing prior work, we also found that attitude towards an event is more salient in the far future than in the near future. But contrary to what we had hypothesized, we found that thinking about perceived behavior control is not just limited to when the event is near. In the distal, people may also consider it if they are sufficiently motivated (have a strong attitude towards the target behavior). To replicate our findings, we conducted an additional between-subject study with 423 Amazon Mechanical Turk workers. Results from Study 2 support findings from Study 1.

This work offers multiple contributions. On a theoretical level, it expands our understanding of how temporal distance affects our judgments of attitude and perceived behavior control. It further helps establish links between the Theory of Planned Behavior and Construal Level Theory, and suggests opportunities to use the TPB factors to assess future behaviors. From a practical perspective, the work provides designer and event organizers with insights and strategies to influence near and far future behaviors .

THEORY OF PLANNED BEHAVIOR

Theory of Planned Behavior (TPB) is one of the most predictive persuasion theories [3,5,21], and has been used in various interventions to encourage behavior change [10,26,48,50]. For example, Chatzisarantis & Hagger [10] promoted physical activity participation by providing persuasive messages targeting behavioral beliefs in TPB. Stead et al. [48] changed people's intention to reduce speeding on roads with a 3-year mass media campaign that was explicitely shaped by TPB's main principles.

In terms of technology design, TPB also provides a framework for various persuasive systems. Thieme et al. [50] used TPB to build a BinCam, a social persuasive system that helps users identify barriers in their personal abilities, learn about recycling properties, and improve their planning and sharing of food. BinCam motivated reflection and behavioral change in the food waste and recycling habits of young adults. Kharrazi et al. [26] also developed a computer game to help adolescents cope with the consequences of Type1 Diabetes. They used TPB to understand patients' situations and generate tailored game strategies (e.g., knowledge-based strategies, virtual mentors) and found that those strategies increased patients' rates of compliance and adherence to their treatments [26,27].

TPB proposes that behavior can best be predicted from a person's behavioral intention [3]. Behavioral intention (BI) is an indicator of how hard people are willing to try and how much effort they plan to exert toward performing a behavior [37]. The theory also posits that intention is a function of three variables (Figure 1): Attitude (AT: the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question), Subjective Norms (SN: the perceived social pressure to perform or not to perform the behavior.), and Perceived Behavioral Control (PBC: the perceived ease or difficulty of performing the behavior)[3]. As a general rule, the more favorable the attitude and subjective norm, and the greater the perceived control, the stronger the person's intention to perform a behavior should be [13]. Therefore, the greater the individual's intention, the more likely he or she will be to perform a behavior [13]. Meta-analytic reviews of the TPB research provide strong support for the predictive power of the TPB variables; these factors explain on

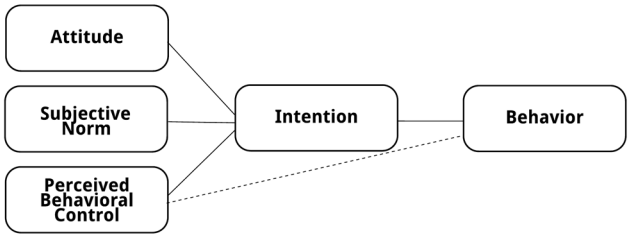

Figure 1. Theory of Planned Behavior

average 40%-50% of the variance in intention, and 19%-38% of the variance in behavior [5,21,49]

Despite the strength of TPB factors in prediciting intentions and behaviors, researchers have raised doubts about the predictive power of the factors as time elapsed between the measurement of intention and the target behavior [49]. In their meta-analysis, Randall & Wolff [41] insisted that the strength of the intention-behavior relationship does not vary according to the time interval between the measurement of intention and behavior (r= -.06, n.s.). Sheeran and Orbell [46], however, argued that the data used by [41] were too sparse to draw this conclusion, and that time interval and behavior type were confounded in their analysis. Instead, they stated that if time interval between the measurement of intention and the target behavior gets larger, the predictive power of intention is attenuated.

While the inconsistent perspective on temporal effect in TPB is problematic for us to use the theory in practice, the general procedure of TPB studies, measuring intention prior to the behavior (1 week, 1 month or 6 months), makes it accerbrated. If intention measured 1 month prior to an event does not actually predict the intention and actual attendance, then is there really a reason to collect that information? The lack of understanding of temporal effect in TPB undermines our ability to utilize the theory to develop strategies and designs to support behaviors. What are the effects of time perspectives on planned behaviors?

TIME PERSPECTIVE & CONSTRUAL LEVEL THEORY

More recent research on Construal Level Theory (CLT) [53] offers an explaination for how factors within TPB may vary as temporal distance to the target behavior changes. CLT states that an individual's temporal distance from a planned behavior is associated with how abstractly he or she will think about the behavior (Figure 2). The mental representation (construal) has different levels (high/low), and the levels of construals affect what information is brought to mind and what is more preferable to the individual [31,51]. Higher-level construal is abstract and more related to the core aspect of a behavior, corresponding to "why" questions. On the other hand, lower-level construal is concrete and more associated with the subordinate aspects of a behavior, corresponding to "how" questions [53]. For example, when planning a behavior (e.g., deciding whether to attend a guest lecture) in the far future, higher-level construal is activated, and thus one tends to focus on the reasons to perform the behavior (e.g., "how interesting the lecture is"). On the other hand, when planning a behavior in the near future, lower-level construal is activated, and one tends to focus on the means to perform the behavior (e.g., "how convenient the time of the lecture is")[31,32,52].

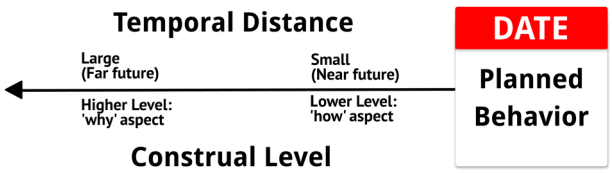

Figure 2. Construal Level Theory

The construal levels, instigated by temporal distances, have been used to explain the actions people prefer as time changes [51]. When thinking about the distant future, people prefer highly desirable behavior as they focus more on the goal of the behavior and less on how to achieve it. On the other hand, when thinking about the near future, people prefer more feasible behaviors even though it might be less desirable because they concern themselves more with the means to reach the goal [32]. Trope & Liberman attribute this tendency to two main reasons [52]. First, people are less likely to have low-level contextual information (e.g., time or places) for behaviors in the further future. Second, people are often not motivated to consider specific, "how" aspects of the situation in which a behavior is to be performed until they get closer in time to that situation. Thus CLT can explain why and how people's intention changes as temporal distance to target behavior decreases. When further away (temporally), desirability (the valence of an action's result) may be driving intention and when closer, feasibility (the ease or difficulty of reaching the result) may be driving intention [53].

Applying CLT into TPB, attitude (AT) may be closely associated with desirability, and perceived behavior control (PBC) with feasibility. Rosenberg [43] has stated that attitude is accociated to important values of the behavior, and is linked to positive versus negative outcomes. Morris considered perceived importance and/or desirability of objects as a cognitive elements of attitude [24]. Furthermore, feasibility is often operationalized and measured as self-efficacy [14,17], which is one of the main components of PBC.

Recent study by Lutchyn & Yzer noted the possible relationship between TPB and CLT [33]. They posit that AT (behavioral) and SN (normative belief) are linked to desirability, and PBC (control belief) is linked to feasibility. They examined how temporal perspectives affect types of salient beliefs. They asked participants to generate thoughts about behaviors (eating fruits and vegetables, condom usage) within various time frames. They found that individuals have more beliefs related to feasibility of the behavior in the near future, but more thoughts related to desirability of the behavior in the distal future [33].

However, the study is limited in several ways. First it does not quite connect the TPB constructs of AT and PBC with the time-dependent beliefs that people generate about the behavior. There is no evidence that AT is considered more in the far future, and PBC in the near future. Further, they were not able to examine what drives intention at different time frames.

Therefore, to build on this idea of connecting TPB with CLT, we conducted two studies to explore how different temporal distances affect peoples' intention to perform behaviors, using TPB factors. First, to replicate results from [33] using TPB concepts, we examine how temporal distance is associated with the amount of a certain type of thoughts. Specifically, we expected people to have more thoughts related to AT (desirability) in the further future, but more thoughts related to PBC (feasibility) in the near future. The hypotheses are:

H1: People will produce more attitude beliefs when considering behaviors in far future than when considering behaviors in the near future.

H2: People will produce more perceived behavior control beliefs when considering behaviors in near future than when considering behaviors in the far future.

Using TPB measures of AT and PBC, we also expect those factors to affect behavior intention differently at different time frames. When making decisions about behavior intention, AT is more salient in the near future, while PBC is more salient in the far future. Our hypotheses are:

H3: AT is a stronger predictor of behavior intention in the far future than in the near future.

H4: PBC is a stronger predictor of behavior intention in the near future than in the far future.

These systematic changes would also help explain why people's general behavioral intention decreases when the date to perform a planned behavior comes. Relating to existing research on the planning fallacy [8], the focus on desirability (while ignoring the various constraints, or the how) in the far future would make people more optimistic [36] and more confident [45] about performing the behavior in the far future. This leads to an over-estimation of intention. But then as the time of enactment closes, the focus on the constraints and costs of participation lowers intention. Thus, we hypothesize:

H5: As temporal distance to a planned behavior decreases, intention to perform the behavior lowers.

STUDY 1

For Study 1, we invited participants to attend a free drop-in yoga class that we had set up for the experiment. Prior to the event, participants were surveyed twice to report their perceptions towards the event, and report on their intentions to attend. The first survey was a month before the yoga class (*far future*), and the second one was a few days before the class (*near future*). We studied how the passage of time affected perceptions of the event.

Participants

Participants were recruited through fliers on public bulletin boards, departmental group mailing lists and the researchers' social networks. Participation was restricted to students at a large University in the Pacific Northwest. This was to ensure that they had access to the university sports complex, where the yoga class was offered. Once participants expressed interest in participating in the study, they received a link to a survey and information about the free drop-in yoga class. They were paid $5 for completing each survey. 45 participants signed up for the study. 38 completed the first survey and out of those, 30 completed the second survey. Responses from the 30 participants who completed both surveys was used for our analysis. 80% of our participants were female (n=24), and participants' mean age was 24.87 (SD=6.85).

Measurements

As a within-subject study, both questionnaires in the far and near future conditions were the same. The survey included three subsets: 1) a open-ended question, "why or why not are you willing to attend the yoga class?" 2) TPB measurements and 3) demographic questions.

TPB measurements included *Behavioral Intention (BI), Attitude, Subjective Norms (SN), and Perceived Behavioral Control (PBC),* all based on [4]. BI was measured with 2 items: 1) I intend to participate in the yoga class; 2) I plan to participate in the yoga class. AT was measured with the following 4 items: For me, participating in the yoga class would be...1) bad-good; 2) useless-useful; 3) unpleasant-pleasant; 4) unenjoyable-enjoyable. SN was measured with 4 items: 1) People who are important to me would approve of my participating in the yoga class; 2) Most people who are close to me would think it is a good idea for me to attend the yoga class; 3) People close to me may think I should participate in the yoga class if they know about it; 4) People I care about would encourage me to attend yoga class. PBC was measured with 4 items: 1) I think I have personal control over participating in the yoga class; 2) It is up to me whether I attend the yoga class or not; 3) If I want, I could easily attend the yoga class; 4) I am confident I could attend the yoga class, if I wanted to. The reliability scale showed our measurments are reliable (Cronbach's α= .95(BI), .93(AT), .92(SN) and .63(PBC); generally if Cronbach's α is larger than .60, the measurement is regarded as internally consistent.)

Analyses & Results

We present our analyses and results. In sum, of our hypotheses, **H1, H2, H5** were supported, not **H3,** nor **H4**.

Thoughts About the Target at Different Time Frames

To test our hypotheses that different temporal distances affect the type of thoughts about the behavior (**H1** and **H2**), we counted the number of thoughts that are related to each TPB construct per person, and examined the difference between the far and near future.

To do so, first, the two researchers separately coded the open-ended responses following the definitions of TPB as coding scheme:

- AT: The degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question (e.g., *"I love yoga for strengthening and stretching my muscles!")*
- PBC: The perceived ease or difficulty ofperforming the behavior (e.g., *"It's free and on campus."*)

Then, they compared what they coded (the agreement rate was 87%), and resolved the discrepancies with a discussion. Once the qualitative coding was finalized, they were converted into quantitative data, using numerical values to statistically test the difference between the far and near future. Each thought was given a numeric value of "+1", and summed up as the total values of each category (AT, PBC). Following [33], each unique thought was considered as one unit. For example, the response "*Yoga is a good way to de-stress. It is challenging yet fun. It's a good form of physical activity*.", was regarded as "3" as the response contains three separate evaluations of performing the behavior: 2 of instrumental attitude (psychological and physical benefit) and 1 of affective attitude (fun). All were related to AT. So this participant had (AT: 3, PBC: 0).

The descriptive statistics show that in total 97 thoughs were generated (the far future: 53, the near future: 44). The average number of thoughts generated per person was 2 (the far future) and 1.53 (the near future). To compare the number of thoughts (AT, PBC) between the far and the near future (**H1**, **H2**), a paired t-test was conducted by comparing the mean number of thoughts per person in two time frames (Table 1). The results show that the mean of thoughts related to AT differs a month before the event (M=1.6, SD=1.00) and a few days before the event (M=.9, SD=1.06) at the .01 level of significance (t(29)=3.00, p<.01). PBC also differs a month before the event (M=.3, SD=.61) and a few days before the event (M=.6, SD=.50) at the .05 level of significance (t(29)=-2.07, p<.05). The results indicate that people have more thoughts related to AT in the far future, compared to the near future; and people have more thoughts related to PBC in the near future, compared to the far future. Both **H1** and **H2** were supported.

Thoughts related to	Far Future	Near Future	Far Future - Near Future (Difference)
Attitude	1.6	.9	.7 **
Perceived Behavioral Control	.3	.6	-.3 *

*p < .05, **p < .01, ***p < .001

Table 1. The Number of Thoughts Related to TPB Variables per Person

Salience of TPB Constructs at Different Time Frames

We hypothesized that AT is a stronger predictor of behavior intention in the far future than in the near future (**H3**) while PBC is a stronger predictor of behavior intention in the near future than in the far future (**H4**). To do so we analyzed the prediction of intention at the two time frames separately using logistic regression. Since BI in 7-scales was not normally distributed (u-shaped); we dichotomized it into the lower (BI<4) and the higher (BI>=4) intentions. Independent variables were the TPB constructs (AT, SN, and PBC). Post Hoc, we built another logistic regression model (Model 2), adding the interaction term of AT and PBC into Model 1.

Logistic regression models were statistically significant for both time frames (the far future: $\chi^2(3)= 13.52$, p<.01; the near future: $\chi^2(3)= 10.90$, p<.05). TPB constructs explained 86.7% of intention (Nagelkerke R^2=.57) in the far future, and, they explained 73.3% of intention (Nagelkerke R^2=.42) in the near future (Model 1 in Table 2).

Examining the coefficients of AT and PBC suggests that **H3** was supported (Model 1 in Table 2). AT negatively predicts BI for the planned behavior in the far future (β=-1.37, odd ratio=.26, p=.08); but its statistical significance drops in the near future (β=.24, odd ratio=1.27, p=.66). It indicates that attitude strongly predicts intention to perform the behavior in the further future, but its predictive power gets much weaker in the near future.

On the other hand, **H4** was not supported. For the behavior in the far future, PBC predicts BI 3.01 times more than other constructs (AT, SN) in the far future (β=1.10, odd

	Model 1						**Model 2** (with an interaction term of AT and PBC)					
	Far Future			**Near Future**			**Far Future**			**Near Future**		
	B	*S.E.*	*Exp(B)*	*B*	*S.E.*	*Exp(B)*	*B*	*S.E.*	*Exp(B)*	*B*	*S.E.*	*Exp(B)*
AT	-1.37†	.77	.26	.24	.54	1.27	5.83	4.26	339.02	-3.10	2.25	.05
SN	1.84†	1.00	6.28	.98	.63	2.66	2.35	1.63	10.45	1.33	.82	3.77
PBC	1.10†	.60	3.01	**1.15***	.54	3.17	**11.55**†	6.62	10373.78	-2.52	2.42	.08
AT by PBC							**-1.61**†	.98	.20	.67	.46	1.96
Model χ^2	13.52 (df=3, p<.01)			10.90 (df=3, p<.05)			17.41 (df=4, p<.01)			13.00 (df=4, n.s.)		
Nagelkerke R^2	.57			.42			.70			.46		
Model Accuracy	86.7			73.3			93.3			70.0		

† p<.1, *p < .05., n.s.=not significant

Table 2. Logistic Regression Analyses on the BI (Attending a yoga class)

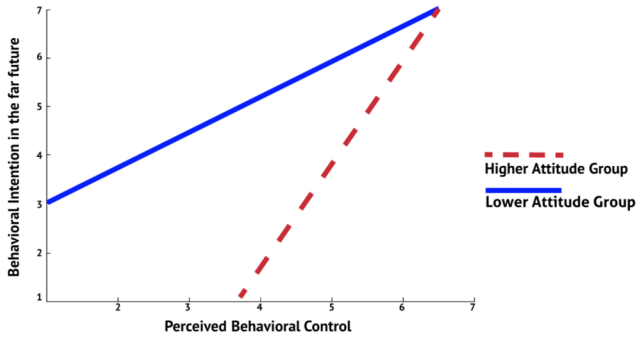

Figure 3. Interaction of AT and PBC in the Far Future

ratio=3.01, p=.07). However, it is not much different from PBC in the near future (β= 1.15, odd ratio=3.17, p<.05), indicating that PBC predicts BI 3.17 times more than other constructs (AT, SN) in the near future.

However, while **H3** seemed to be supported, one concern arose that AT negatively predicts an intention to perform the behavior in the far future, which is contrary to the body of prior work that suggests a positive relation between AT and intention. This led us to further explore the result of the qualitative study to understand what may have caused this. Connecting these ratings with the belief responses, we found that people who hold the most positive attitude towards participating in the yoga class (AT > 6) in the far future actually described more feasibility-related issues to perform the planned behavior. Further, they are also likely to give a low intention rating. For example, one participant (AT= 6.5, BI = 1) wrote: *"I have a meeting 3-5 on Friday. That sounds cool and otherwise I would like to do it though!"*. Another participant (AT = 7, BI = 1) wrote: *"I will be out of town on that date. I would love to attend a free class on a different date."*

Reading these results suggested that there may be a possible interaction between AT and PBC. Those with higher AT are perhaps more likely to factor in PBC in their assessment of BI. Thus, we tested a version of the model with the interaction terms included (Model 2 in Table 2). For the far future, there was a significant interaction effect between PBC and AT in (B=-1.61, odd ratio=.20, p=.10); the Omnibus Tests of Model Coefficients showed that including the interaction term improved the model ($\Delta\chi^2$ =3.9, p<.05). Graphing the relationships between PBC, AT and BI by grouping participants into higher AT (AT>6.00) and lower AT groups confirmed that indeed those with higher AT are more likely to factor in PBC in their judgement of BI (Figure 3). If their rated PBC is low, they are significantly less likely to say they will attend.

On the other hand, for the near future, including the interaction effect did not improve the model fit significantly ($\Delta\chi^2$= 2.11, p=.15).

Change in Intention Over Time

We hypothesized that people tend to have a higher intention to perform the behavior in the far future compared to near future (**H5**). Results of the paired-samples t-test show that the mean of willingness to attend the yoga class differs a month before the event (M=.80, SD=.41) and a few days before the event (M=.60, SD=.49) at the .01 level of significance (t=2.70, df=29, p<.01, 95% CI, for a mean difference .05 to .35, r=.62). We should point out that in the end, only 6 participants actually attended the yoga class (20%). This is a significant drop from 80% to 60% to 20%.

Discussion

In this study, we found that people's focus on their attitudes towards a future behavior decreases as temporal distance to the behavior decreases, while their focus on perceived behavior control increases. This change in salience of TPB factors affects their judgements on intention.

The effects on AT and PBC on behavior, however, is more nuanced than we had hypothesized. We had expected AT to have a stronger influence in the far future and PBC to have a stronger influence in the near future, as people transition from the why (high level construal) to the how (low level construal). However, what we found is that there is an interaction effect. In the near future, PBC is a significant predictor of intention as people focus on the how of behaviors. But in the far future, PBC may not be completely ignored and AT itself may not be the dominant factor. Those who hold higher positive attitudes toward the behavior seemed to also consider PBC in their judgements of intention.

This finding does not necessairily contradict CLT. As discussed earlier, Trope and Lieberman [52] explained that levels of CLT change due to people being less likely to have the motivation to be informed about the situational context of the far future. This also connects to research on dual process models [9,15,40], which suggests that there are

Attitude	Reasons
7	Time conflict.
7	I've never taken an actual yoga class.
	I'd love to experience it.
	I've heard great things about yoga.
7	Yoga is good exercise and relaxing.
7	I have work then.
7	I will not be a student on campus this spring.
6.8	I want to begin attending classes at the IMA
6.8	I am always trying to incorporate more yoga into my fitness routine because I find it to be an important and satisfying way to work out
	I usually just end up going for a run instead.
6.8	Get to experience a different teacher and potentially a different style of yoga

Table 3. Thoughts Generaged by People with the Highest Attitude Towards the Class a Month before the Event (Far Future)

two types of information processing: systematic (central) vs. heuristic (peripheral) process. The former is more detailed and elaborate, which is effortful, whereas the latter uses simple rules and heuristics and less deliberation.

Findings have shown that when a person is motivated to think about an object, he or she tends to process information more systematically and logically, to elaborate on the message, to estimate the missing details, and therefore to eventually predict the future more accurately [9,15,40]. Prior work explored the relationship between CLT and dual-processes [20], but it still remained unclear how they are associated to future behaviors.

Our findings suggest the highly motiaved people may process information systematically, and hence, consider all relevant information more thoroughly. In other words, people who hold stronger AT toward the behavior may be more intrinsically interested in the behavior—and are thus more motivated to consider the planned behavior carefully. While doing so, they consider the various outcomes of the behavior including both desirability and feasibility of the planned behavior. Thus an alternative hypothesis to our **H4** would be:

H6. In the far future, PBC would predict behavior intention more strongly for those who report high AT.

STUDY 2

To further replicate the interaction effect of AT and PBC on the BI, we conducted a second study, a between subject experiment. Using this opportunity, we also expanded on the generalizability of this work by studying three different behavioral contexts instead of one**:** eating five servings of fruits and vegetables (health), going camping (recreation), and donating to a thrift store (donation).

There are a couple of key differences between Study 1 and Study 2 that we should note. First, unlike Study 1 where participants were invited to and could attend a real yoga event, Study 2 asked about hypothetical future behaviors. This was to enable us to study a wide range of behavior which was harder for us to coordinate (e.g., eating fruits and vegatables). Also, we used a between subjects design to minize problems associated with participant dropout (In Study 1, 8 out of 38 participants dropped out in between two surveys of Study 1). We also tested three different time frames (tomorrow, a week from now, a month from now). Thus there were 9 conditions (3 behaviors x 3 time frames).

Participants

Participants were recruited from Mechanical Turk. They received $1 for their participation. Workers were restricted to those residing in the US to ensure their basic English proficiency. 457 participants completed the questionnaire, titled "Survey about Intention to Perform an Action." Our manipulation check showed that 34 participants were unable to recall the time frame and behavior they were assigned; they were removed from our analyses. In total, we included the remaining 423 participants (233 male, 189 female, 1 other), who ranged in age from 19 to 68 years (M= 33.89 years, SD=10.9). The breakdown of participants per condition is shown in Table 4.

		Health	Donation	Camping
Far future (n=281)	A month from now	45	52	46
	A week from now	52	42	44
Near future (n=142)	Tomorrow	45	50	47

Table 4. The Number of Participants in each group

Measurements

The questionnaire used was similar to the one used in Study 1, but slightly modified for the different conditions of Study 2 (Appendix). Again, the questions have three subsets: 1) thoughts toward behavior performance in a certain time frame with an open-ended prompt, "Please generate any positive or negative thoughts of performing the given behavior"; 2) TPB questionnaires (BI, AT, SN, and PBC); and 3) demographic questions. All questionnaires were internally consistent (Cronbach's α: BI=.98, AT=.91, SN=.77, and PBC=.83).

Analyses & Results

We present the results of our analyses. Our hypotheses, **H1, H2, H5** and **H6** were supported.

Thoughts About the Target at Different Time Frames

Following the same coding scheme used in Study 1, two researchers coded the responses. Then, they compared the results (the agreement rate was 90%), and resolved the discrepancy with a discussion.

The descriptive statistics show that total 2517 thoughts were generated (far future: 1680, near future: 837). The average number of thoughts generated per person was 5.98 (far future) and 5.89 (near future).

Results of a one-way analysis of variance (Table 5) revealed that the mean of thoughts related to AT differs in the far future (M=4.4, SD=2.30) and in the near future (M=3.8, SD=2.20), and the difference between two time frames is statistically significant ($F(2,422)=3.411$, $p<.05$). PBC also differs in the far future (M=1.2, SD=1.33) and in the near future (M=1.7, SD=1.72), and the difference is statistically significant ($F(2,420)=6.51$,$p<.01$). The result is same as Study 1. Both **H1** and **H2** were supported.

Salience of TPB Constructs at Different Time Frames

Similar logistic regression models used in Study 1 were used here to study the effects of AT, SN and PBC on BI. Interaction between AT and PBC was included to test H6.

Thoughts related to	Far Future	Near Future	Far Future - Near Future (Difference)
Attitude	4.4	3.8	0.56**
Perceived Behavioral Control	1.2	1.7	-0.5***

*$p < .05$, **$p < .01$, ***$p < .001$.

Table 5. The Number of Thoughts Related to TPB Variables Per Person

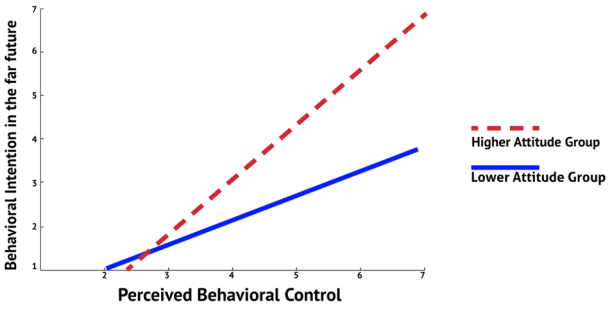

Figure 4. Interaction Effect of AT and PBC

As a control, we included the type of behavior: health, donation or recreation. While we had initially planned to compare the 3 time frames, we found that there was no significant difference between the groups of a week from now and a month from now in terms of intention (Tukey HSD test, mean difference = .054, p=.55). Thus we collapsed those cells together, and focused on the contrast between near future (tomorrow) and far future (a week to a month from now).

To test H6, we built two sets of logistic regression models: Model 1 is with TPB constructs, and Model 2 has an additional interaction term of AT and PBC in Model 1.

Comparing the two sets of models, we found that in the far future, including the interaction term resulted in a better fit (Omnibus Test of Model Coefficients: $\Delta\chi^2$=3.92, p<.05). On the other hand, including the interaction term did not improve the model in the near future (Omnibus Test of Model Coefficients: $\Delta\chi^2$= 1.25, p=.27). These results are similar to what we found in study 1. Thus, we focus our interpretations of finding using the model with the interaction (Model 2) for the far future, while using the model without the interaction (Model 1) for the near future (although they are presented in full in Table 6). In the far future, the factors explain 85.1% of intention to perform a behavior (Model 2: Nagelkerke R^2= .71) ; in the near future, the factors explain 88.7% of intention to perform a behavior (Model 1: Nagelkerke R^2= .62).

Supporting findings from study 1, again we found that PBC is a significant positive predictor in the near future (B=.62, odd ratio=1.86, p<.01) Also that the interaction term was significant in the far future, supporting **H6** (Figure 4 & Model 2 in Table 6). There was a significant interaction effect between PBC and AT in the far future (β=.27, odd ratio=1.31, p<.05), suggesting that PBC moderates the relation between AT and BI when a behavior is planned in the far future.

		Health(%)	Donation(%)	Camping(%)
Far future (n=81)	A month from now	38(84)	16(30)	5(11)
	A week from now	34(65)	9(21)	2(4)
Near future (n= 24)	Tomorrow	27(60)	4(8)	2(4)

Table 7. The Number of Participants in each group who are Willing to Perform Behaviors

We should note that the two interaction graphs are slightly different. For Study 1 (Figure 3), BI is similar for participants at higher PBC and differs at lower PBC, whereas in study 2 (Figure 4), BI is similar for participants at low PBC and differs at high PBC. This suggests that making PBC more salient may have differing effects for those with high attitude—sometimes thinking about the detals may reduce intention, other times improve intention. The specific differences we observed may have been due to the different target activities or participant sample.

Change in Intention Over Time

To test **H5**, we conducted a one-way analysis of variance to compare the difference in intention between time frames, and it was also supported like Study 1.

People report lower intention for behavior when temporal distance is smaller. In the near future, only 33 out of 118 participants (23.2%) intended to perform the behavior. On the other hand, when the behavior is planned in the further future, 104 out of 281 participants (37%) intended to perform the behavior (see details in Table 7). A one-way analysis of variance revealed that the differences are statistically significant (F(1,421) = 8.30, p <.01).

	Model 1						**Model 2** (with an interaction term of AT and PBC)					
	Far future			**Near future**			**Far future**			**Near future**		
	B	*S.E.*	*Exp (B)*	*B*	*S.E.*	*Exp (B)*	*B*	*S.E.*	*Exp (B)*	*B*	*S.E.*	*Exp (B)*
AT	.36*	.17	1.44	.12	.28	1.12	-.92	.70	.40	-.53	.62	.59
SN	1.00***	.22	2.70	.73**	.28	2.07	.89***	.23	2.43	.65*	.29	1.92
PBC	.71***	.18	2.04	.62**	.24	1.86	-.76	.78	.47	-.29	.84	.75
Behavior (Health)	***			***			***			***		
Behavior (Donation)	2.21***	.60	9.12	2.47**	.91	11.81	2.28***	.62	9.75	2.49*	.93	12.04
Behavior (Camping)	.60	.59	1.81	-.60	1.01	.55	.64	.60	1.90	-.52	1.03	.60
AT by PBC							.27*	.14	1.31	.16	.14	1.17
Model χ^2	201.24 (df = 5, p<.001)			75.64 (df = 5, p<.001)			205.16 (df=6, p<.05)			76.89 (df = 6, n.s.)		
Nagelkerke R^2	.70			.62			.71			.63		
Model Accuracy	85.1			88.7			86.1			89.4		

*p < .05, **p < .01, ***p < .001., n.s.=not significant

Table 6. The Logistic Regression on Intention to Perform a Behavior

DISCUSSION

In this paper, we sought to explore a simple, yet extremely important question: whether and how do the factors that influence behavior intention change as the temporal distance from the planned behavior changes. We found that the salience of different factors that influence intention (i.e., AT, PBC) changes, depending on time. As shown by the belief responses collected in both studies, the salience of the Attitude (AT) towards the behavior decreases as temporal distance decreases (**H1**). At the same time, the focus on the Perceived Behavior Control (PBC) increases as temporal distance increases (**H2**).

But our results are more nuanced than simply AT is dominant in the distal and PBC in the proximal. In both studies, our results indicate an interaction effect between these two factors (**H6**). This interaction effect suggests that in the near future, PBC is a significant predictor of intention, as people focus on the feasibility of the event. But that in the far future, PBC may still be an important predictor of intention, especially for those who hold higher AT towards the planned behavior.

These results offer several contributions to theory. First, they extend the Theory of Planned Behavior (TPB)[2]—one of the most often cited and used behavior change theories—by incorporating the temporal perspective. Many researchers have noted the limitations of TPB when it is used to understand behavior intentions that are not in the proximal [12]. Others have also noted that incorporating time into TPB is a critical and open challenge [11]. Using CLT, we were able to link the different factors that influence intention as proposed by TPB, with the high and low level construals as used in CLT. Specifically, we showed the potential connection between AT component of PBC with high level construals, used to reperesent distal events, and PBC component of TPB with low level contruals, used to represent proximal events. AT is more about the why, or the desirability of an event, while PBC is more about the how, or the feasibility of an event. Incorporating concepts from CLT into TPB, we believe, enables us to better understand how the proposed factors influence future behavioral intention.

In addition, the interaction effect we found also provides important insights about the relationship between TPB, CLT, and dual-process models [9,15,40] that need further exploration. Ajzen posits that AT, SN, and PBC are conceptually separate [2], and lots of prior works have examined the different predictive power of each construct [5,13]. However, others have suggested that some of the factors may interact with each other to influence behavior [13]. Our research suggests that what information people use to base their judgements on is both influenced by time (CLT) and by motivation to process, as suggested by dual-process theories. According to dual theories, when a person is motivated and also has the ability, one uses the central path to process the information, elaborate on the content, estimate the missing details, and eventually predict more accurately. Conversely, when the motivation or ability to think about the information is missing, one uses the peripheral path to process the content heuristically. People's attitude towards a behavior can make them more motivated about the target and use the central route of processing [29]. Thus, in the distal, those who hold strong attitudes may not just consider desirability, but also take the additional step to think about feasibility (PBC). To use an example: imagine if you were asked to participate in an event in the future. You are probably more likely to take out your calendar and check if the event has a conflict (PBC) if you care about the event (high AT). If you do not care about the event (low AT), you will not take the effort to find and process the additional information related to the how. These relationships are important consider. If we do not include this type of interaction effect in our models, it may even be possible to erroneously conclude that AT has a negative influence on behavior, as we had found in Study 1.

While not part of our hypothesis, we do also want to make a note about the subjective norm (SN) component of TPB. Unlike the other factors, subjective norm appears to be a stable predictor of the intentions regardless of temporal distance. This is different from the hypothesis in [33], which argues that SN is closer to desirability and thus should be influenced temporally like AT. We hypothesize, based on our findings, that SN may be both related to desirability and feasibility. Our qualitative analysess provide some supporting evidence. For example, when considering eating five servings of fruits and vegetables tomorrow, one respondent mentioned, *"I could easily be a vegetarian but my husband prefers all meat."* In this case, the normative pressure may be more about PBC (hard to do it). Future research should explore this hypothesis as the influence of SN on intention may also be time-dependent in more subtle ways.

Designing for Temporal Changes of Planned Behavior

From a practical perspective, our results also hold important implications for designing interventions to support behavior change. As highlighted in our findings, people's intention to perform a target behavior decreases as the date to perform the behavior approaches. We found a 15-20% decrease in intention when the target is a few weeks away compared to a few days away. A lot of existing research has talked about nudging and encouraging behavior change, but have ignored the issue of time. The same strategy that works to encourage immediate participation may not be as effective in helping encourage people to make their initial commitments (e.g., RSVP). How might we better design to support behavior change goals at different time frames? Here we outline some strategies.

Goal #1: To Encourage Proximal Participation or Stick to Plans

If one aims to encourage people to participate in a proximal behavior, or stick to their plans in the near-term, our findings suggest that designs need to be salient and support

the belief of feasibility of the behavior. This includes reducing the cost of participation (e.g., providing transporation to the event), and also highlighting the ease of doing it (e.g., "you just need to show up!"). To get people to stick to behaviors for something they have already committed to, scheduling systems (e.g., virtual assistant services, calendar systems) or event organizing systems (e.g., RSVP, e-invitation) can also provide tailored notifications, based on temporal distance from planned behaviors. When the planned date gets closer, notifications could offer more information that support the how of performaing the behavior (e.g., showing videos of others performing the tasks, discuss other related performance accomplishments), to help improve users' self-efficacy.

Goal #2: To Get Widespread Attention from People

When marketing a new event, or when promoting campaigns, or when introducing new functions in the system, designers and event organizers may need to gain early and widespread attention from people. Our findings suggest that in these secnearios, one should focus on increasing positive attitudes toward events or activities. One way to encourage people to have positive attitude toward activities is to present the multiple reasons why they should perform the behaviors, focusing on instrumental (e.g., how important or useful the behavior could be) and affective anticipations (e.g., how pleasant or fun the behavior could be) that they may have. For example, if an organizer aims to publicize volunteering events a month in advance, the advertisement should focus on the fun aspects of the event. The high RSVP count and social media shares can then help generate buzz towards an event. Further, research on public commitments has also shown getting people to make those commitments can strengthen behavioral compliance [1].

Due to the potential interaction between AT and PBC, if the target behavior is hard to perform (i.e., low behavior control), the designers or organizers may want to reserve the above strategy to those who are not already vested or motivated to attend (e.g, not on the members' mailing-list or the secondary target market). This might help prevent the set of people who already hold a strong positive attitude towards the target from thinking even more deeply about it and then deciding not to participate right away due to feasibility conccerns, undermining the goal of garnering widespread attention.

Goal #3: To Improve RSVP Accuracy

One of the drawback from the above scenario, is that while that strategy may work to get more people to care and sign up early, there may still be a problem of a high dropout rate due to the decrease in intention over time. There are scenarios where designers and organizers may not care how many people sign up initially, but want a better assessment of how many people will actually attend. Not showing up to an event may disappoint others who would expect him/her to do so (e.g., family), and hamper the best utilization of staff and resources (e.g., over/understaffing)[34].

Based on our findings, what one could do is to motivate people to consider feasibility when making their intention judgements. One strategy to increase processing motivation, as we have discussed, is to encourage positive attitude towards the event. But another way to encourage more detailed considerations, is by providing people the "ability" to participate. For example, when designing the RSVP, designer could include and highlight additional information related to the how of the event, such as actual distance (projected time to travel) to an event, weather forcast, and other costs. The RSVP can also point out potentially conflicting events. Encouraging people to think more and spend more time on the decision, may also enable them to make more accuracte assesssments of the future behaviors.

LIMITATION

Different limitations for the two sets of study results due to the different study designs. In Study 1, as a field study, we focused on one behavior, attending the yoga class. The within-subjects nature of the study also made it hard for us to account for potential confounds that may occur from the dropouts. To address these issues, we replicated the findings in study 2 with additional hypothetical behaviors and using a between-subjects design. However, this came at the tradeoff of reducing the realism of the study. While results from both studies, using these different approaches, supported each other, more research is needed to replicate and build on our findings.

CONCLUSION

In this paper, we studied the role of temporal distance in planned behaviors through two experiments. In Study 1, we conducted a within-subjects field study with 30 participants to examine how intention to attend a free yoga class changes over a month. We found that, supporting prior work, people's intention to perform a behavior lowers as the temporal distance decreases. People also think more about attitude (relating to the why) in the far future than in the near future. But contrary to what we had hypothesized, we found that thinking about perceived behavior control is not just limited to when the event is near. In the distal, people may also consider it if they are sufficiently motivated (strong attitude towards the target). To replicate our findings, we conducted an additional between-subject study with 423 Amazon Mechanical Turk workers. Results from study 2 support the findings from study 1. Findings help extend Theory of Planned Behavior with the temporal dimension, particularly focusing on the interaction effect of each TPB construct. We also conclude with three design strategies for interventions depending on behavior change goals and temporal distance from the target behavior.

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