

The Importance of Timing in Mobile Personalization
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With the increased prevalence of smart mobile devices and applications, understanding what is important to a mobile user at a point in time is an area of increasing focus. Many current applications have approached this problem by trying to tailor the user experience by using various aspects known about the user’s location as the user context. The next step in personalization is determining what is of interest to the user beyond just the user’s immediate situation. A number of studies have tried to address this issue from the perspective of predicting the next location based on prior travel history [1]. In this work, we examine the question of what may be relevant based on what future events a user will be planning beyond just the next activity. To explore this we address two key questions: 1) when are plans made about a particular type of activity; 2) how do the different aspects of these plans get finalized.

Examining travel patterns has been an area of significant focus in transportation planning research. A common theme of these studies is that travel does not occur simply to get from point A to point B, but each travel segment is instead the result of there being an activity need – it is this need that drives the travel and the destinations visited [2]. Thus, when it comes to predicting the information that is relevant to the mobile user outside of the immediate location, these are the factors that must be considered.

One approach to this problem would be to assume that what is going to be relevant is based primarily on the immediately previous destinations. By analogy, this is similar to the approach taken in web data mining. Specifically, the next web page a user is likely to visit is based on the immediately prior visits in a user’s click stream. Where this analogy breaks down is that in reality when people plan where they will be going throughout the day or week it is not regarded in such a fashion. Specifically, studies have shown that people often plan their activities hours or even days in the future rather than making spur of the moment decisions at each step of their travel. Thus, when considering context relevant to a mobile user, it is also critical to consider how far in advance plans are made – referred to as a user’s “planning horizon”. An interesting aspect of this is that not all attributes of a trip are finalized at the same time. For example: if a group of friends decides to go out socially on a Friday night, there may be several stages as to what aspects of that activity are set. Suppose they decide on dinner and a movie several days in advance. From a planning perspective the details where, when, and who for dinner may be decided upon at that time and the activity of going to a movie afterwards decided upon, however, which theater to go to after may not be decided upon until the day before or later. Thus, when considering the context relevant to a user there may be some aspects of even the same activity that may be more relevant at different times than others.

Another consideration is how frequently a particular activity is likely to be scheduled. In this regard a similar problem has been examined in e-commerce related to web recommendation based on recurrent purchases (such as toner for a printer) [3]. Within these models the general approach is to try to determine the usage habits of a consumer and then use this information to infer that future purchases will likely be spaced similarly. For mobile users, there are definitely some similarities. For example, with grocery shopping, the frequency of shopping trips, while not the same from household to household, is probably similar within the same household. However, there is a significant difference between these two problems. First, when a person is buying toner online there generally isn’t a huge time expense if that purchase happens at one part of the day over another. However, whether a trip to the grocery store is on the way or significantly out of the way plays a major role in deciding whether to do the activity at that particular time or wait until another time. The second consideration is the sequential dependency of timing. In particular, if items that require refrigeration are being purchased the stop cannot just occur when the trip is on the way, instead it must occur whenever a stop at home will occur soon after. It is because of these differences that more needs to be considered than just frequency of activity.

To explore these aspects of schedule planning horizon, a travel activity and planning survey was conducted of 100 households over the course of two weeks [4]. Table 1 depicts a portion of these results specifically focusing on the planning of activities and attributes of those activities for events the participant didn’t consider part of their routine. An analysis of these types of events showed that 45% of these activities were planned sometime prior to the immediate next activity. Table 1 depicts a breakdown of when different aspects of the planning for that activity occurred. For example, if we look at when the location of the activity is planned related to when the activity itself is preplanned (row 2 of the location attribute); we note that the location itself is often not decided upon until the same week rather than when the original activity was planned. This type of insight could be used to help determine information that is relevant to the user’s context even if it is hours or days before the activity occurs.

Attribute	Activity Plan Horizon	Attribute Plan Horizon			
		Routine	Same Day	Same Week	Over a week
Duration	Same Day	12%	87%	1%	1%
	Over a week	12%	61%	17%	9%
Location	Same Day	9%	87%	3%	1%
	Over a week	9%	6%	53%	31%
Mode	Same Day	27%	59%	8%	6%
	Over a week	23%	23%	33%	21%
Start Time	Same Day	6%	93%	1%	1%
	Over a week	9%	29%	41%	22%
Who With	Same Day	6%	89%	5%	1%
	Over a week	13%	8%	48%	31%

Table 1: When different aspects of discretionary activities are planned

[1] Anagnostopoulos, C. B.; Tsounis, A. & Hadjiefthymiades, S.; Context Awareness in Mobile Computing Environments, *Wireless Personal Communications*, 2007, 42(3)

[2] Timmermans, H.: *Progress in Activity-Based Analysis*. Elsevier (2005)

[3] Hung, S.-S.; Li, L.-H.; Hsu, R.-W. & Tsai, P.-J. The personalized recommendation with bundling strategy based on product consuming period, *Proceedings of the International Conference on Computational and Information Science 2009*, 461-469.

[4] Frignani, M.Z., Auld, J., Mohammadian, A., Williams, C., Nelson, P.; Urban Travel Route and Activity Choice Survey (UTRACS): An Internet-based Prompted Recall Activity Travel Survey Using GPS Data. *In Proceedings of 89th Annual Meeting of the Transportation Research Board*, 2010.