

Real time experience tracking and human behavior tracking: Macro and micro approaches to measuring tourist behavior

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I. Introduction

This paper is in response to calls for advancing measurement approaches in tourism including collection of detailed information on tourist behavior (see MOVE 2013's call for papers). Based on the marketing concepts of "primary" and "secondary" demand² (Rossiter and Percy, 1997), we demonstrate how tourists' behavior could be assessed at the primary or macro level (for example, intentions to visit cultural attractions), and at secondary or micro level (for example, by tracking tourist activities in a museum). These methods are novel in that they rely mostly on digital devices to measure behavior.

The paper is organized as follows. Section II outlines the theory of primary demand and illustrates its application. Similarly, Section III outlines the rationale behind human-behavior tracking and demonstrates its uses in tourism attractions. Finally, Section iv highlights the usefulness of the macro / micro approaches for DMOs.

II. Primary Demand Assessment

Theory

Assume that a visitor's motive in visiting a destination is intellectual stimulation or mastery (for example, study the local culture). This motive energizes the individual to pay attention to information about cultural attractions, for example, and attain its concept (Rossiter, 1996). While the traditional "paid" media still plays a major role in information provision, DMOs today can use many forms of media to reach consumers at the moments or touch points that most influence their decision (Table 1).

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² Primary demand denotes demand for the product category as a whole (for example, cultural attractions), whereas secondary demand is defined to include demand for constituents of cultural attractions such as museums, theatres, etc.

Insert Table 1 about here

What is a touch point? Touch points relate to consumer decision stages (see the BSM concept in Rossiter and Percy (1997)). Extant research on tourist decision making (see for example, Ritchie and Hudson, 2009; Woodside and MacDonald, 1994) suggests that decisions to visit attractions are made not only up-front, before visiting a destination, but also during the visit (cf. the point-of-purchase concept in marketing). Expressed as a flow-diagram, the tourist decision journey shown in Figure 1 suggests that: (i) the visitor will have plans to visit a set of attractions (initial-consideration set); (ii) expand or narrow the consideration set based on touch point influences, and (iii) visit the attractions.

Insert Figure 1 about here

As an example, assume that a tourist has decided to visit art galleries and monuments based on exposure to television commercials, magazine and newspaper ads, search-engine results, DMO's websites, etc. Although research into tourist's initial-consideration set is sparse (Moutinho, 2000) we estimate it to be one attraction, on average, per weekend trip³. Furthermore, contrary to the traditional purchase-hierarchy, funnel model (Rossiter, 1996), the number of attractions under consideration tend to expand during the actual visit (see the State of Georgia's FY2012/13 Tourism Marketing Summary). In fact, a majority of households in our qualitative research stated that the initial-consideration set expanded due to "earned" media influences. For one tourist, it was a hand-painted sign in a hotel lobby that welcomed visitors to an art show that triggered the expansion. For another it was the recommendation of a filling station attendant that made him visit a "muscle-car" museum.

The point is that DMOs need to know tourists' touch points so that they can be influenced, where possible.

Measure

Real time experience tracking (McDonald et al 2012) is a mobile phone application (app) designed to extract four pieces of information from a customer's interaction: product involved, the type of touch point (for example, the customer may have called a toll free number to learn about the product), how the customer felt about the touch-point experience, and whether it persuaded the customer to try or repeat-buy the product. The app is a short-message-service (SMS) based survey that requires a text message as response to all forms of encounters (seeing an advertisement, talking to other users of the product, etc.).

We adapt this app to measure tourist behavior at the macro level. To illustrate, assume that a tourist visits Chicago, USA, with an intention to enjoy the history and culture of the region. Further, assume that the tourist is willing to participate in the visitor survey. Once in Chicago, before the start of her tours, the tourist will complete an online questionnaire about her awareness, attitudes, and intentions to visit one or more of the attractions listed by the Chicago DMO on its website: Art galleries, museums, exhibitions, theaters, historic sites, etc. (see

³ We obtained this number from a qualitative research conducted earlier among a convenience sample of 20 households in west-central Illinois (Athiyaman 2012).

<http://www.choosechicago.com/things-to-do/>). Then, during her travels, she would text a four-character message whenever she encounters or come across stimuli relevant to the attractions and maintain an online log of her experience. Finally, at the end of her travels, she would complete an exit survey which would mimic the first online survey so that changes in her awareness, attitudes, and behavior toward attractions could be gauged. Figure 2 is a schematic representation of the methodology.

Insert Figure 2 about here

Validation

The “real time tourist tracker” was field tested among a convenience sample of tourists in Chicago, Illinois. Respondents were visitors to a toll-way oasis outside of Chicago (route I-88 toll-way) during the start of a weekend (Friday between 5PM to 9PM). Three graduate students recruited participants to the study using an “intercept” form. Briefly, the intercept form screened the participants for appropriateness (for example, that they are visiting Chicago for the weekend, willing to SMS, etc.), and introduced them to the study. In all, 27 visitors agreed to be part of the study. They were requested to self-administer an online survey. The survey included questions about awareness of tourist attractions: What tourist attractions are you thinking of visiting during the weekend? Questions about benefit beliefs: For example, “Do you believe that the admission fee to visit the Field Museum is not at all expensive, somewhat expensive, moderately expensive, or very expensive. Questions about benefit beliefs and behavioral intentions were limited to six tourist attractions that the authors believed to be salient for Chicago: Field Museum, Hancock observatory, Lincoln Park Zoo, Millennium Park, Navy Pier, and Sears Tower. Behavioral intention question was of the form, “If you were going to visit cultural attractions, how likely it is that you will visit the Field Museum”. Appendix 1 shows the survey designed using the django-crowdsourcing application.

Fifteen respondents (56%) remained engaged with the program and sent at least one SMS. The most frequently cited touch point was friends’ recommendations. In terms of Table 1 concepts, it is the earned media that had the greatest influence on visitors’ attraction choice, followed by “owned” and “sold” media (Table 2). Other results of interest include:

1. Expansion of initial consideration set: initially, only one in 27 respondents stated her intention to visit Sears Tower. But during the visit, eight other respondents included it in their itinerary. Communications from other travelers were responsible for this change.
2. The changes in pre-visit, post-visit scores for both attitudes and behavioral intentions for the attractions were attributed to impersonal, contextual factors such as crowd and noise.

Insert Table 2 about here

III. Secondary Demand Theory

The theory is simple: By monitoring visitor activities in an attraction, a context-aware, assistive system can help attraction personnel to initiate just-in-time visitor assistance. This should

enhance visitor satisfaction. A satisfied visitor is expected to not only repeat visit the attraction, but also engage in positive word-of-mouth and word-of-mouse.

Broken down into its components, the theory requires that we interpret multiple sensor signals to recognize visitor behaviors and provide assistance when needed to enhance their satisfaction. However, a simple thought on the subject reveals the complexity of applying the theory. For example, there are no constraints on the sequence and duration of visitor “browsing” behavior of exhibits in a museum. One visitor may start with exhibit 1 and progress linearly to exhibits 2, 3, and so on. Another may start with exhibit 3 and then proceed to exhibit 1. Yet, to gain competitive advantage in the industry, tourist attractions need to understand different visitor behavior and respond accordingly to satisfy needs.

Methodology

The task is to predict nature of activities associated with a sequence of sensor events. For example, a visitor in a museum may look “lost” if she randomly walks around the exhibits halls. To find such activity states, we utilize naïve Bayes classifier.

The Model

Assume that attraction x has n sensors to model human behavior within its “closed” environment. If we consider only binary sensors, then n of them will record 2^n events. Getting back to our museum visitor example, for a given observation sequence $O = \{O_1, O_2, \dots, O_t\}$, the probability that the visitor is lost can be found as:

$P(o_i/Lost) = \prod_n P(o_i/ Lost)$, which can be expressed as:

$$C_{NB} = \arg \max_C P(C) \prod_i p(o_i/ C),$$

where NB = Naïve Bayes, and C = the event’s category which in our example is “lost” or “not lost”.

To calibrate this model, we utilize a “training” data set. To illustrate, assume that we have sensor data from a museum. Specifically, for each of the 3 binary sensors, we have data as follows:

Visitor	Sensor 1	Sensor 2	Sensor 3	Event (Category)
V1	1	0	0	Not Lost
V2	1	1	1	Lost
.
.
.
V10	1	1	1	Lost

Based on this training data set, we estimate $P(Lost) = .36$, for example, and $P(Not Lost) = .64$. The conditional probabilities for sensors could be:
 $P(\text{Sensor 1 is active} / \text{the visitor is lost}) = .33$;

$P(\text{Sensor 2 is active} / \text{the visitor is not lost}) = .1$, and so on for each of the 16 sensors by category combinations.

For a new instance (visitor), we may have:

$P(\text{Lost}) P(\text{Sensor 1 active} / \text{Lost}) P(\text{Sensor 2 active} / \text{Lost}) P(\text{Sensor 3 active} / \text{Lost}) = .005$

$P(\text{Not Lost}) P(\text{Sensor 1 active} / \text{Not Lost}) P(\text{Sensor 2 not active} / \text{Not Lost}) P(\text{Sensor 3 not active} / \text{Not Lost}) = .025$

Based on the above, we classify the visitor as “not lost”.

Validation

The setting was a small regional museum in western Illinois (see Figure 3). The museum curates one or two events in a year all concerned with historic artifacts of the region. In 2012 the museum attracted around 3000 visitors. The average visitor tends to be elderly (65+ years of age) who has passion for all things “classic”.

Insert Figure 3 about here

The museum didn’t allow us to set up sensors so we engaged in experiments and participant observations. To elaborate, 10 male graduate students were asked to visit the museum. They were then tracked by the first author who noted down where they went, stopped, as well as what they did (for example, picked up an information sheet about an exhibit). In all four activities were recorded. They include: (i) attraction power of an exhibit: whether the student stopped by an exhibit or not; (ii) holding power: whether the student spent adequate time reading information about the exhibit⁴; (iii) sweep statistic: whether the student moved quickly or not through the museum space⁵, and (iv) Typical flows: whether the student travelled the well-trodden path or not⁶. The observer recorded the students’ actions in an experiment data sheet (Table 3).

Insert Table 3 about here

The results of the Naïve Bayes model, the conditional probabilities, are shown below:

$P(\text{Lost}) = 0.3$

$P(\text{Not Lost}) = 0.7$

$P(\text{Attraction power} = \text{Yes} | \text{Lost}) = 2/3$

$P(\text{Attraction power} = \text{No} | \text{Lost}) = 1/3$

$P(\text{Attraction power} = \text{Yes} | \text{Not Lost}) = 4/7$

$P(\text{Attraction power} = \text{No} | \text{Not Lost}) = 3/7$

$P(\text{Holding power} = \text{Yes} | \text{Lost}) = 2/3$

$P(\text{Holding power} = \text{No} | \text{Lost}) = 1/3$

⁴ It ranged from 10 seconds to 45 seconds.

⁵ The average length of museum visit of 20 minutes was used as the criterion to score this variable.

⁶ The museum personnel helped us “map” the often used route.

$P(\text{Holding power} = \text{Yes} \mid \text{Not Lost}) = 3/7$

$P(\text{Holding power} = \text{No} \mid \text{Not Lost}) = 4/7$

$P(\text{Sweep stat} = \text{Yes} \mid \text{Lost}) = 2/3$

$P(\text{Sweep stat} = \text{No} \mid \text{Lost}) = 1/3$

$P(\text{Sweep stat} = \text{Yes} \mid \text{Not Lost}) = 4/7$

$P(\text{Sweep stat} = \text{No} \mid \text{Not Lost}) = 3/7$

$P(\text{Typical flow} = \text{Yes} \mid \text{Lost}) = 1/3$

$P(\text{Typical flow} = \text{No} \mid \text{Lost}) = 2/3$

$P(\text{Typical flow} = \text{Yes} \mid \text{Not Lost}) = 1/7$

$P(\text{Typical flow} = \text{No} \mid \text{Not Lost}) = 6/7$

To test our theory: that is, to enhance visitor satisfaction and overall service quality perceptions, a visitor should be provided with the right service at the right time, we observed three visitors to the museum, predicted their behavior using Naïve Bayes, and interviewed them individually to gauge the predictive accuracy of the model and their satisfaction with the visit. The results are shown in Table 4.

Insert Table 4 about here

As shown in the Table, the predictive accuracy of the model was 66%. Visitor V_1 did not admit that she was lost. When asked whether they would have liked assistance such as museum personnel providing additional information about one or more exhibits that held their attention, one respondent said that she doesn't like being interrupted. Another opined that it depends on the time she has; it appears that she often walks in to the museum to wait for friends.

iv. Implications

These are the takeaways for DMOs:

1. Touch points are mostly driven by tourists: they "pull" information at all stages of the visit (pre-visit, during and post-visit).
2. Concept attainment or learning about a tourism product often happens during a visit to a destination. This learning is mainly due to word-of-mouth from friends, family, and host-destination's contacts.
3. The methodology used to assess primary demand (real-time tourist tracker) is superior to conventional one-time, questionnaire-based, exit survey of visitors in providing insights about tourist behavior. Specifically, it minimizes reporting errors caused by memory lapses in revealing touch points.
4. Visitor behavior tracking helps enhance visitor satisfaction.

Regarding further research on the topic, time didn't permit us to use the same respondents to test both the methodologies. However, we have launched an initiative in non-metro Illinois to implement the measurement approaches outlined in the paper. We intend to approach NSF for funding the project..

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Table 1: Media Types

Media	Definition	Examples
Paid	The DMO pays to promote its products	TV commercials, print ads, search-engine marketing.
Owned	DMO's own channel for advertising	Web sites, Facebook pages
Earned	Third party create media or share DMO's media to discuss about attractions, etc.	Consumer ratings, discussions on forums such as TripAdvisor.
Sold	DMO invites other businesses to place their content on its owned media	Selling ad-space on DMO's web site.
Hijacked	DMO's ad campaign is taken hostage by those who oppose it	Opposition creates and distribute negative ads about the DMO

Note: Adapted from Edelman and Salsberg (2010).

Figure 1: Tourist Decision Journey

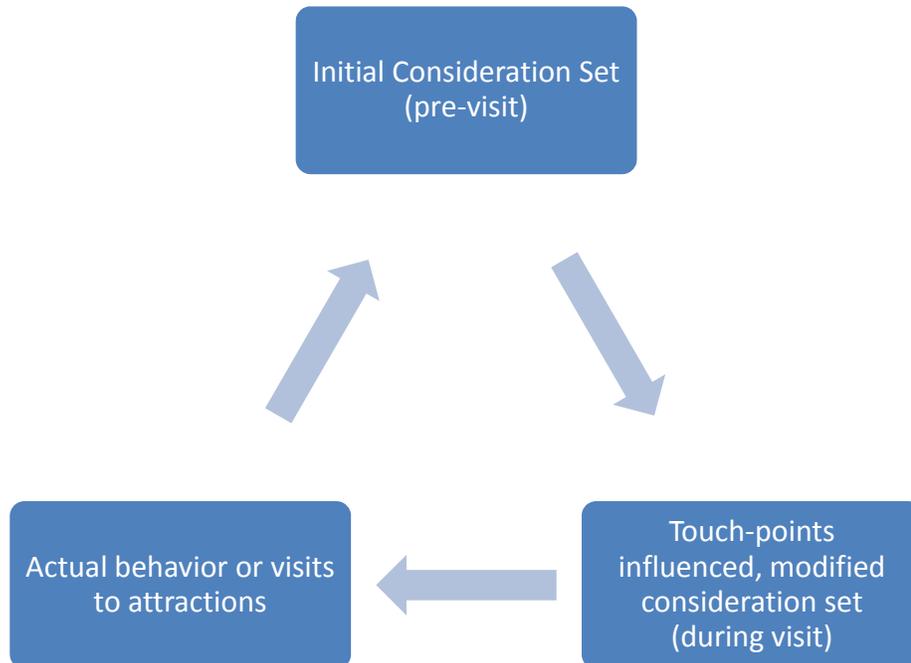
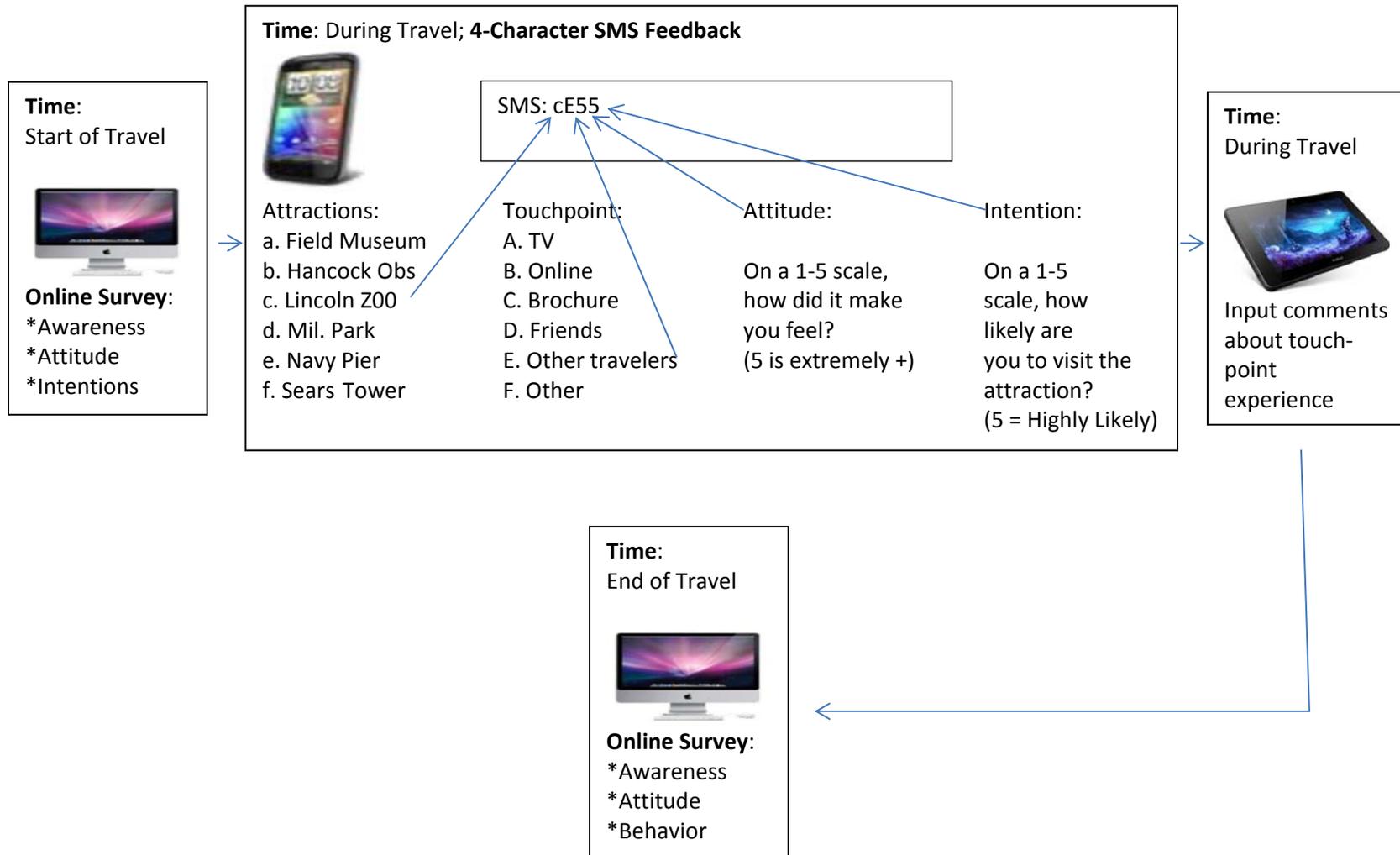


Figure 2: Real Time Experience Tracking: Macro Level Measure of Tourist Behavior



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Table 2: Results of Primary Demand Analysis

Pre-visit, online-survey results:

What tourist attractions are you thinking of visiting during the weekend?

Attraction	% Intending to Visit (n = 27)	Attraction	% Intending to Visit (n = 27)
Shedd Aquarium	22	Museum of Science and Industry	7
Lincoln Park Zoo	20	John Hancock Center	4
Navy Pier	17	Sears Tower	3
Millennium Park	16	Other	2
Field Museum of Natural History	9		

Pre-visit Survey and Post-visit Survey Average Attitude Scores

Attraction	Pre-Chicago-Visit Score (n = 27)	Post-Chicago-Visit Score (n = 15)
Field Museum of Natural History	4	2
John Hancock Center	6	3
Lincoln Park Zoo	2	5
Millennium Park	3	7
Navy Pier	8	8
Sears Tower	7	4

Pre-visit Survey and Post-visit Survey Average Behavioral Intentions Scores

Attraction	Pre-Chicago-Visit Score (n = 27)	Post-Chicago-Visit Score (n = 15)
Field Museum of Natural History	63	30
John Hancock Center	30	65
Lincoln Park Zoo	11	12
Millennium Park	48	54
Navy Pier	43	33
Sears Tower	88	84

SMS Responses (n = 18)

Attraction	Touch Point	Attitude	Behavioral Intention	% of SMS
Sears Tower	Other travelers; DMO's website	+5	+5	50

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Millennium Park	Friends	+5	+5	33
Field Museum	Friends	+5	+4	17

Figure 3: Setting for Secondary Demand Analysis



Table 3: Experimental Observations

Subject	Attraction Power	Holding Power	Sweep Stat	Typical Flow	Category (Lost = No)
S1	No	Yes	Yes	No	Yes
S2	Yes	No	No	No	Yes
S3	Yes	No	Yes	No	No
S4	Yes	No	No	No	Yes
S5	No	Yes	Yes	No	Yes
S6	Yes	Yes	Yes	No	Yes
S7	Yes	Yes	No	No	No
S8	No	No	Yes	Yes	Yes
S9	Yes	No	No	No	Yes
S10	No	Yes	Yes	Yes	No

Table 4: Results of Secondary Demand Assessment

Visitor	Attraction Power	Holding Power	Sweep Stat	Typical Flow	Prediction	Accuracy of Prediction
V1	No	No	No	Yes	Lost	Not accurate
V2	Yes	Yes	No	Yes	Not Lost	Accurate
V3	Yes	Yes	Yes	Yes	Not Lost	Accurate

Note: Predictions were based on conditional probability numbers given on p. 5.

All predictions were validated by individual depth interviews with the visitors. However, no intervention was made hence no satisfaction impacts could be gauged. One visitor noted that, “Usually I am stressed with crowd, architecture, etc. so I don’t appreciate intrusion during my walk around in the museum”.

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Appendix 1: Questionnaire Measures

Available from the first author upon request.

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