Separating Effects of Social Influence and Choice Consistency in Sequential Stated Adaptation Experiments

Xiaofeng Pan*, **Soora Rasouli**, **Harry Timmermans**
Eindhoven University of Technology
Department of the Built Environment, Urban Planning Group
PO Box 513, 5600MB Eindhoven, Netherlands
* Corresponding author (e-mail: x.pan@tue.nl)

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1 Introduction

As an important element of choice behavior, social influence did not attract much interest in discrete choice analysis until the very beginning of this century. In their seminal work, Brock and Durlauf (2001, 2002) suggested a discrete choice model which extended the representative part of the utility function by adding a so-called social utility term, which was associated with the market shares of alternatives in a social reference group. Several studies followed this definition of social influence and developed model frameworks in the context of travel mode choice (Dugundji and Walker, 2005; Dugundji and Gulyás, 2008), telecommute decisions (Páez and Scott, 2007), residential location choice (Páez et al., 2008) etc.

Sequential adaptation experiments are believed a suitable approach to investigate social influence because the sequential nature of the experiment clearly shows how an individual behaves before and after knowing the behavior of others in a social reference group (e.g., Kim et al., 2017, 2014). However, in a sequential adaptation experiment, the sequence of choices may not reflect pure social influence if choice consistency of an individual is not taken into consideration. In case in the first stage an individual chooses an alternative that is exactly the one a social network member would choose and in the second stage the individual continues choosing this alternative, the observed sequence of choices cannot differentiate between choice consistency and social influence. Moreover, if in the first stage an individual chooses an alternative that is different from the one a social network member would choose and in the second stage the individual conforms to the social network member's choice, the sequence may still not tell the individual's adaptation behavior is caused by low choice consistency or high positive social influence.

Based on the above considerations, this study tries to measure social influence as well as choice consistency using a sequential stated adaptation experiment. Specifically, choice of city trip itinerary is taken as an example. Results show that individuals' choice consistency has an effect on adaptation behavior.

2 Model Framework

A sequential stated adaptation choice task consists of 2 stages of choices, in which respondents make choices in terms of a same choice profile before and after being informed about a certain social network member's choice. In this study only a single social network member´s choice is provided. Therefore, the utility function of alternatives in the 2 stages are defined as follows:

$$U_j^1 = V_j^1 + \varepsilon_j^1 = \sum_k \beta_k x_{jk} + \varepsilon_j^1,\ j \in J \tag{1}$$

$$U_{j_1}^2 = V_{j_1}^2 + \varepsilon_{j_1}^2 = V_{j_1}^1 + (1-d)\cdot\theta + \lambda + \varepsilon_{j_1}^2 = \sum_k \beta_k x_{j_1 k} + (1-d)\cdot\theta + \lambda + \varepsilon_{j_1}^2,\ j_1 \in J \tag{2}$$

$$U_{j_2}^2 = V_{j_2}^2 + \varepsilon_{j_2}^2 = V_{j_2}^1 + d\cdot\mu + (1-d)\cdot(\theta+\lambda) + \varepsilon_{j_2}^2$$

$$= \sum_k \beta_k x_{j_2 k} + d\cdot\mu + (1-d)\cdot(\theta+\lambda) + \varepsilon_{j_2}^2,\ j_2 \in J \tag{3}$$

$$U_{j'}^2 = V_{j'}^2 + \varepsilon_{j'}^2 = V_{j'}^1 + \varepsilon_{j'}^2 = \sum_k \beta_k x_{j'k} + \varepsilon_{j'}^2,\ j' \in J,\ j' \neq j_1,\ j' \neq j_2 \tag{4}$$

The superscript "1" and "2" indicate stage 1 and stage 2, respectively. J is the choice set. j_1 is the alternative that has been chosen in stage 1 by a respondent. j_2 is the alternative that is a social network member´s choice. j' is the third choice option which is neither the choice of respondent not the choice of social network. d is a dummy variable, $d = 1$ if $j_1 \neq j_2$, otherwise, $d = 0$. μ and λ are parameters indicating magnitude of social influence and choice consistency, respectively. θ is a parameter indicating correction for choice consistency triggered by social influence. V_j^1, $V_{j_1}^2$, $V_{j_2}^2$ and $V_{j'}^2$ are deterministic utility terms, which are represented using linear-additive form. ε_j^1, $\varepsilon_{j_1}^2$, $\varepsilon_{j_2}^2$ and $\varepsilon_{j'}^2$ are random error terms.

To sum up, a social-influence term, denoted as μ, is added to the utility of which is chosen by a social network member and another term, denoted as λ, is added to the utility of which is chosen in stage 1 to indicate choice consistency. Further, in the case that the choice in stage 1 and choice of a social network member are the same (i.e., $j_1 = j_2$), the influence of the social network member' choice may differ, so it acts as correction of choice consistency rather than social influence, denoted as θ. In addition, if an individual's adaptation behavior does not observed, i.e. sequential adaptation experiments are not used, then $\lambda = 0$. The proposed model reduces to those that only consider the effect of social influence.

Assume the error terms follow IID extreme value type I, a MNL model is generated. Maximum likelihood method could be applied for estimation. To avoid confounding of taste parameter β_k and parameters μ, λ and θ in stage 2, we suggest using sequential estimation. Another thing should be noted is that the utilities $U_{j_1}^2$ and $U_{j_2}^2$ in stage 2 are established based on the choices in stage 1, therefore, the MNL model could only give conditional probability of each alternative in stage 2, which should not be adopted directly to examine marginal effect of social influence.

3 Estimation Results

To examine the validity of the proposed model, choice of city trip itinerary was taken as an example. Respondents were asked to choose one from three stated itineraries before and after knowing a certain social network member's choice, which was randomly generated considering the cost and difficulties of collecting data on real social network choice. A web-based survey was carried out. Totally, 808 respondents successfully completed the questionnaire, of which 756 were deemed valid and used in this study. Estimation results are presented in the following tables.

Table 1. Estimation of taste parameters in stage 1

	Estimate	Std. error	p-value[a]
Alternative Attribute			
Aircraft type			
Propeller	-0.2438		
Jet	0.2438	0.0262	**0.0000**
Charge for checked baggage			
Not for the first one	0.0159		
Yes	-0.0159	0.0258	0.5371
Charge for airline meals			
No	0.0646		
Yes	-0.0646	0.0265	**0.0146**
Flight departure time			
6:00 ~ 9:00	0.4504		
9:00 ~ 17:00	0.3430	0.0446	**0.0000**
17:00 ~ 21:00	-0.2332	0.0460	**0.0000**
21:00 ~ 24:00	-0.5602	0.0478	**0.0000**
Frequent flyer member			
No	-0.0418		
Yes	0.0418	0.0254	0.0997
Seat space			
Small	-0.2361		
Wide	0.2361	0.0256	**0.0000**
On-time performance			
60%	-0.0634		
70%	-0.1340	0.0424	**0.0016**
80%	0.0656	0.0435	0.1314

90%	0.1318	0.0436	**0.0025**
Ticket price (€)			
69	1.2125		
139	0.3690	0.0447	**0.0000**
209	-0.4622	0.0458	**0.0000**
279	-1.1193	0.0554	**0.0000**
Constant (Itinerary1)	0.1453	0.0534	**0.0065**
Constant (Itinerary2)	0.3712	0.0521	**0.0000**
Initial log-likelihood		-3322.204	
Final log-likelihood		-2534.357	
Rho-squared		0.2371	
Adjusted Rho-squared		0.2323	
Sample Size		3024	

Note: [a] p-value those less than 0.05 are marked in bold

Table 2. Estimations for social influence and choice consistency in stage 2

	Estimate	Std. error	p-value[a]
Choice consistency (λ)	2.3199	0.0989	**0.0000**
Social influence (μ)	0.7935	0.1156	**0.0000**
Correction for choice consistency (θ)	0.1457	0.1474	0.3230
Initial log-likelihood		-2557.097	
Final log-likelihood		-1597.164	
Rho-squared		0.3754	
Adjusted Rho-squared		0.3742	
Sample Size		3024	

Note: [a] p-value those less than 0.05 are marked in bold

With respect to estimation in stage 1, the adjusted Rho-squared is 0.2323, showing good model performance. All taste parameters have the expected sign, and most are significant at least at the 95% level. With respect to the estimation in stage 2, the adjusted Rho-squared is 0.3742, representing good model performance. Choice consistency and social influence are positive and significant at the 95% level, while correction for choice consistency is insignificant though it is also positive. Besides, the magnitude of choice consistency is much higher than the magnitude of social influence. Therefore, compared with individuals' own preference, the behavior of others only has modest positive effect. Ignoring individuals' choice consistency may lead to estimation bias.

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