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SEARCH CONSTRAINT OF MOBILE TECHNOLOGY AND CHANNEL CHOICE IN E-COMMERCE

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ABSTRACT

This study aims to investigate empirical evidence of search constraints of the mobile technology from the theoretical lens of technology affordance. Using a large archival panel dataset encompassing transactions in the PC and mobile channels, we find that information-intensity of products is negatively associated with the choice probability of the mobile channel over the PC channel. However, the negative association is weakened as the user experience in the mobile channel accumulates, suggesting a dynamic relationship between user and technology (i.e., users' learning or adaptation to technology).

Keywords: Mobile channel, search constraint, e-commerce, channel choice, technology affordance

INTRODUCTION

Mobile technologies are transforming e-commerce markets. The mobile channel has rapidly been established as a major transaction channel, possibly substituting for or complementing existing channels. Mobile technologies are also transforming user behaviors. While the mobile channel provides a higher level of spatially flexible access vis-à-vis the online channel (*ubiquitous access capability* of the mobile channel), it is still limited in terms of information search-related usability vis-à-vis the PC channel (*limited information search capability* of the mobile channel) [1].

This study aims to investigate empirical evidence of search constraints of the mobile channel from the theoretical lens of technology affordance. As Orlikowski [16] underlines, "[users'] understandings of technology are neither fixed nor universal, but … they emerge from situated and reciprocal processes of interpreting and interacting with particular artifacts over time" (p.8). Therefore, users' electronic channel usage is not a static or deterministic outcome resulting from their profile, preexisting needs, or technology features, but flexible and dynamic decisions that can change with their usage context and experience. The notion of technology affordance provides more flexible approach to the issue than media theories [4] [5] or channel capability theories [1], which posit each medium has invariant communication capacities or technological features. Rather than solely focusing on the role of technological features and deterministic relationship between the user and technology, the affordance lens can guide us to explore interplays between them.

We examine users' *purchase channel choices* between the PC and mobile channels while taking account of the *information-intensity* of the products. If limited user interfaces of mobile devices indeed hinder extensive information search in the mobile channel, the mobile channel would be less preferred for transacting information-intensive products. However, according to the technology affordance, this search constraint would be dynamic as the user experience with the technology accumulates. A user might feel some difficulty in purchasing products on small mobile screen at her first attempt, but will find it easier to do next time. Therefore, we also examine users' adaptation to the mobile channel by looking at the behavioral dynamics in sequences of choices over time, i.e., how the channel choice probabilities evolve as a user's purchase experience in the mobile channel accumulates.

The rest of the paper is organized as follows. We present theoretical background of the study and develop hypotheses. Next, we conduct empirical analyses by applying a random coefficient Bayesian logit model to a large scale transaction dataset from an e-market. We conclude by discussing implications of the study.

THEORETICAL BACKGROUND AND HYPOTHESES

Channel Choice

Researchers have widely discussed consumers' purchase behaviors in a multi-channel environment, primarily on their channel choices [3] [7] [13]. A common lesson from these studies is that channel choice is not a straightforward decision. There are a variety of factors that can affect the choice, such as transaction costs [2], channel-category associations and geodemographics [10], informational trust and convenience [3], and consumers' information needs and information retrieval from channels [13]. Also, the probability of the choice can change over time as consumers' experiences in each channel accumulated [17] [19].

Although prior studies present useful insights regarding consumers' purchase behaviors in a multi-channel environment, there are important gaps in the literature. First, most studies have analyzed purchase behaviors between offline, online, and catalog channels, leaving out mobile channels. Second, prior studies provide limited guidance on the relationship between product category and channel choice because their analyses usually focus on a single product category [3] [13] [19]. A notable exception is Inman et al. [10] who focused on associations between product categories and offline channels (drug store, mass store, club store, and grocery store). They showed that consumers' channel choice decisions are significantly different across product

categories, and that geodemographic factors can play an important role in explaining channel shares of volume; however, such factors are not applicable to the case of channel choices between the PC and mobile channels, both of which are electronic media to which physical distance to a shop is irrelevant.

Search Constraint of Mobile Channel and Purchase Channel Choice

While a variety of types of information are available to e-market users, including product descriptions, customer reviews, price information, and delivery and return policies, all of the information is not critical to all product categories that consumers evaluate. Some product categories (e.g., home furniture or cameras) involve extensive searches in terms of the number of pages viewed and the total time spent on search, whereas other categories (e.g., health or beauty products) entail much less extensive searches [9].

Product information-intensity refers to "the amount of information a consumer needs to process before making purchase decisions" [1]. Other things being equal, information-intensive products are likely to lead to more in-depth searches and/or broader searches for product information. Given the search constraints of the mobile channel, the information-intensity of a product may affect which channel consumers would prefer to use. The search constraints of mobile channels would be critical to e-market users' channel choices when purchasing products with high information-intensity, while the users might be affected less by the search constraints when purchasing products with low information-intensity. However, the search constraints do not remain constant, as suggested by the technology affordance perspective [14] [15] [16]. Users could adapt to purchasing products on small screens and limited user interfaces in mobile channels. As their purchase experiences in mobile channels accumulate, they would get accustomed to interacting with mobile screens and purchasing products using mobile devices. The authors' anecdotal evidence from an interview with a manager of an e-market supports this point.

"We are surprised that our customers begin to purchase big ticket items in the mobile channel. Although still negligible comparing to online sales, products like TV, laundry washing machine, and refrigerator are now being sold through the mobile channel, and the number is going up beyond our prior expectation."

The above discussion leads to the following hypotheses:

H1. *Information-intensity of products is positively associated with the choice of PC channel over the mobile channel.*

H2. *The association between information-intensity and channel choice is weakened as the user experience in the mobile channel accumulates.*

EMPIRICAL ANALYSIS

Data

This study employs a large dataset from a major e-marketplace in South Korea, which introduced the mobile channel on June 1, 2010 to its more than ten million users of the existing PC channel. The dataset contains a random sample of 30,000 users, who adopted the mobile channel before June 1, 2011, and their entire online orders (1.18 million) and mobile orders (0.11 million) placed during March 1, 2009-June 1, 2011. The dataset consists of a variety of variables related to each order including the product category, price, order time, and order channel (PC or mobile).

Since our interests lie in channel choices of users, 24,684 users who had less than four mobile transactions after they made their first transaction in the mobile channel were excluded from the analysis. Further, 72 business users were also dropped. Remaining 5,244 users and their entire 155,091 order records after their mobile channel adoptions were used for the analysis.

Table 1 shows descriptive statistics of the main data. The data consists of 98,045 online and 57,046 mobile orders. The average price of mobile orders was significantly less than that of online orders (the difference = 5.8, $t = 14.47$, $p < 0.001$), indicating that products transacted through the mobile and online channels could be different. A chi-square test on orders by hour of day also shows that there were significant differences between mobile and online channels in terms of order time ($\chi^2_{(23)}$=1.3e+03, $p <$ 0.001). Among the 5,244 users, there were 2,826 female and 2,418 male users, and most of them were less than or equal to 35 years old. The average membership duration for the e-marketplace was 733.6 days.

To measure the number of attributes of a product, we gathered data from another e-marketplace, *Danawa.com*, where the attribute information of a product is provided using the attribute discriminator of slash ('/') as shown in Figure 1. For example, if a product has three attributes A, B, and C, then the attribute information would be shown as A / B / C. The upper product in Figure 1, a desktop computer by Samsung Electronics, has 11 pieces of attribute information including 'Intel,' the CPU maker, 'Core i5-4590 (3.3GHz),' the CPU model, '2GB,' the main memory size, 'DDR3,' the main memory type, etc. Similarly, the lower product in Figure 1, a HP desktop computer, has 17 pieces of attribute information.

We counted the number of the attributes for each product listed in the first page for each product category and then averaged the numbers because products in a category may have different number of attributes. The average was used as a proxy measure for the information-intensity of the product category.

Table 1. Basic Description on Data

Total Number of Orders		**155,091**
	Online Orders	Mobile Orders
Number of orders	98,045	57,046
Average order prices in USD (Std.)	28.2 (90.5)	22.4 (43.4)
Number of orders by hour of day		
00h	5,493	2,821
01h	3,990	2,350
02h	2,466	1,402
03h	1,947	1,017
04h	1,171	688
05h	982	560
06h	912	663
07h	1,278	1,088
08h	2,029	1,463
09h	3,089	2,219
10h	4,169	2,643
11h	5,543	5,258
12h	5,122	3,110
13h	5,690	3,459
14h	5,342	3,153
15h	5,195	3,056
16h	5,230	3,033
17h	5,060	2,830
18h	4,592	2,402
19h	4,189	2,093
20h	4,799	2,612
21h	5,841	2,828
22h	6,555	2,996
23h	7,361	3,302
Total Subjects		**5,244**
Gender	Female	2,826
	Male	2,418
Age	≤ 20	398
	21~25	1,376
	26~30	1,635
	31~35	951
	36~40	487
	41~45	172
	46~50	95
	51≤	130
Average membership duration in days (std.)[1]	733.6 (307.7)	

Note: [1] Duration as of June 1, 2011.

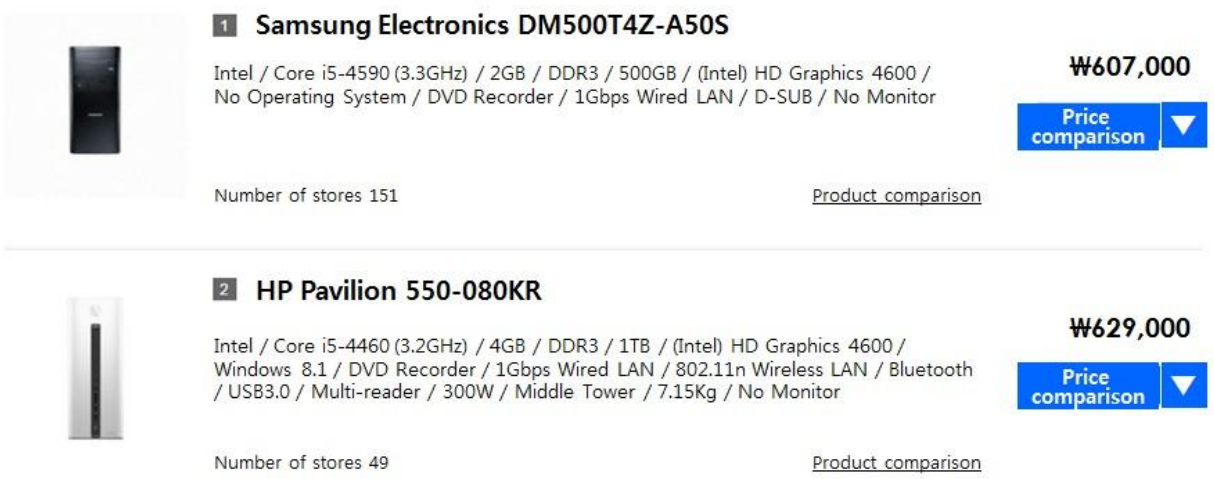

Figure 1. Illustration of Product Attributes at *Danawa.com* (translated in English)

Model Specification

We consider a channel choice function of a user with covariates of information-intensity of product, user experience in the mobile channel, and purchase time. This can be modeled as a binary choice. The utility of mobile channel choice for user *i* at choice *k*, U_{ik}, is given by

$$U_{ik} = \boldsymbol{x}_{\boldsymbol{k}}^{'}\boldsymbol{\beta}_{\boldsymbol{i}} + \boldsymbol{z}_{\boldsymbol{ik}}^{'}\boldsymbol{\gamma}_{\boldsymbol{i}} + \varepsilon_{ik} \qquad (1)$$

where the $\boldsymbol{x}_{\boldsymbol{k}}^{'}$ represents variables that vary with only choices (i.e., order time), the $\boldsymbol{z}_{\boldsymbol{ik}}^{'}$ represents variables that vary with users and choices (i.e., user experience), and the error term is assumed to follow *i.i.d*. Gumbel type II extreme value distribution.

We have three sets of variables that could influence users' channel choice behavior. The first set of variables is the order time, T_{tik}, which is a dummy variable representing whether the user *i* made the order of the k^{th} choice at hour (of day) *t*. As shown in Bang et al. (2014), access affordance of the mobile channel affects purchase time; therefore purchase time should be controlled for in the choice model. To this end, a total of 23 dummies, $t = 0, 1, \ldots, 22$, were employed. For example, $(T_{0ik}, T_{1ik}, \ldots, T_{22ik}) = (0, 0, \ldots, 0)$ represents that a purchase made between 23h and 00h, and $(T_{0ik}, T_{1ik}, \ldots, T_{22ik}) = (1, 0, \ldots, 0)$ represents that a purchase made between 00h and 01h.

The second set of variables is the measures for information-intensity of the purchased product. We use two objective measures of the information-intensity: the number of product attributes (or bulleted descriptions) and the product price. The number of product attributes is widely used or recognized as the proxy for the amount of information that should be processed before a purchase [9] [11]. Sellers provide information on product attributes to help consumers make purchase decisions. A TV seller, for example, provides product information such as brand, type, display technology, screen size, and resolution, all (or some) of which might be considered as the input for our purchase decision. As explained in the preceding subsection, we employ a proxy measure AAT_{ik}, the average number of attributes of the purchased product category at the k^{th} choice of user *i*,

We also took the product price (PRI_{ik}) as the proxy measure for the information-intensity of the product. Consumers typically spend more time for information search when purchasing expensive products. Prior studies also empirically confirmed that product price is an important determinant of search intensity across a variety of product categories [12]. PRI_{ik} is the product price at the k^{th} choice of user *i*,

The third one is the transaction experience in the mobile channel. Prior studies suggest consumers' channel choice probabilities change as their experience in the channel accumulates [17]. In order to explore the behavioral dynamics in sequences of choices over time, we include EXP_{ik}, is the number of transactions made through the mobile channel before the k^{th} choice of the user *i*.

Furthermore, it would be unrealistic to assume that channel choices by the same user are uncorrelated with given observed covariates. To control for unobserved heterogeneities, we employed a random coefficient Bayesian logit model. The model allows us to control for effects from individual-specific time-invariant factors on the channel choice (preference heterogeneity) with individual (user)-specific intercepts. Also, the model considers heterogonous effects of covariates across users using random coefficients.

The affordance perspective suggests that technology constraint is not at a standstill, but changes as users adapt to the technology.

For example, a user might feel difficulty in purchasing products on the small mobile screen at his first attempt, but may find easier to do it next time. To capture the changing nature of the associations between the covariates and channel choices, we included interaction terms between *EXP* and other two covariates *AAT*, and *PRI* in the model.

Then, the model specification is:

$$\text{logit}(\pi_{ik}) = \beta_i^{PRI} PRI_{ik} + \beta_i^{AAT} AAT_{ik} + \beta_i^{EXP} EXP_{ik} + \sum_{t=0}^{22} \tau_t T_{tik} + \beta_i^{PRI \cdot EXP} PRI_{ik} EXP_{ik} + \beta_i^{AAT \cdot EXP} AAT_{ik} EXP_{ik} + \alpha_i + u_{ik} \quad (2)$$

where π_{ik} is the conditional probability that user i chooses the mobile channel at k^{th} choice, β_i^X is the coefficient of covariate $X \in \{AAT, PRI, EXP\}$ for user i, τ_t is the coefficient for the transaction hour of day, α_i is the individual fixed effect, and u_{ik} is the error term.

Results

Table 2 shows the analysis results from the random coefficient Bayesian logit model.

The effects of the product price and the number of product attributes, two proxy variables measuring the information-intensity of the purchased product, are negative and significant. This result presents empirical evidence of search constraint of the mobile channel, thereby supporting H1. We also note that the effect of the mobile channel transaction experience is positive and significant, indicating users are more likely to choose the mobile channel as their transaction in the mobile channel accumulates.

Table 2. Random Coefficients Bayesian Logit Results

Variable	Null Model	Main Model	Interaction Model
PRI	–	-0.030 (0.000)***	-0.020 (0.000)***
AAT	–	-0.961 (0.022)***	-1.001 (0.020)***
EXP	–	0.021 (0.000)***	0.054 (0.012)***
*PRI * EXP*	–	–	7.2E-4 (1.2E-4)***
*AAT * EXP*	–	–	0.014 (0.000)***
Hour1	0.183 (0.044)***	0.177 (0.044)***	0.178 (0.044)***
Hour2	0.218 (0.051)***	0.221 (0.052)***	0.222 (0.052)***
Hour3	0.184 (0.058)***	0.192 (0.058)***	0.192 (0.058)***
Hour4	0.216 (0.068)**	0.203 (0.069)**	0.204 (0.069)**
Hour5	0.388 (0.075)***	0.368 (0.075)***	0.368 (0.075)***
Hour6	0.510 (0.072)***	0.498 (0.072)***	0.498 (0.072)***
Hour7	0.600 (0.060)***	0.604 (0.060)***	0.604 (0.060)***
Hour8	0.417 (0.052)***	0.415 (0.053)***	0.417 (0.053)***
Hour9	0.502 (0.046)***	0.502 (0.046)***	0.502 (0.046)***
Hour10	0.329 (0.043)***	0.328 (0.043)***	0.328 (0.043)***
Hour11	0.720 (0.039)***	0.606 (0.039)***	0.604 (0.039)***
Hour12	0.286 (0.041)***	0.279 (0.041)***	0.280 (0.041)***
Hour13	0.247 (0.040)***	0.252 (0.040)***	0.252 (0.040)***
Hour14	0.236 (0.041)***	0.247 (0.041)***	0.248 (0.041)***
Hour15	0.235 (0.041)***	0.241 (0.041)***	0.242 (0.041)***
Hour16	0.186 (0.041)***	0.194 (0.041)***	0.194 (0.041)***
Hour17	0.121 (0.042)**	0.124 (0.042)**	0.124 (0.042)***
Hour18	0.010 (0.043)	0.008 (0.043)	0.009 (0.043)**
Hour19	-0.092 (0.044)*	-0.086 (0.045)	-0.085 (0.045)
Hour20	0.010 (0.043)	0.012 (0.043)	0.012 (0.043)
Hour21	-0.003 (0.041)	0.007 (0.041)	0.007 (0.041)
Hour22	-0.092 (0.040)*	-0.087 (0.040)*	-0.086 (0.040)*
Hour23	-0.082 (0.039)*	-0.077 (0.039)*	-0.076 (0.039)*

Note: *within *95%, **99%, ***99.9% credible intervals*

To examine the user adaptation to the mobile channel, we incorporate two interaction terms between the transaction experience in the mobile channel and the measures for the information-intensity of the purchased product. The interaction term between the price and the experience is positive and significant, indicating that the negative association between the product price and the mobile channel choice is weakened as user experience in the mobile channel accumulates. The interaction term between the number of product attributes and the experience is also positive and significant, meaning that the negative association between the number of product attributes and the mobile channel choice become weaker as user experience in the mobile channel increases. Positive and significant coefficients of both interaction terms collectively provide empirical evidence of user adaptation to the mobile channel, supporting H2.

DISCUSSION AND CONCLUSION

In this study, we empirically examined the search constraint of the mobile channel in e-commerce. Using a large scale archival dataset from a sample of mobile channel users encompassing their e-commerce transactions in the PC and mobile channels, we investigated the relationship between information-intensity of products and users' purchase channel choices between the PC and mobile channels.

We demonstrate search constraints of the mobile channel with the negative association between the product information-intensity and the likelihood of mobile channel choice. Furthermore, the result suggests the dynamic relationship between user and technology (i.e., users' learning or adaptation to technology), which is another important aspect of technology affordance. That is, limited mobile user interfaces could become less of an obstacle or could even be overcome as users gain more experience in the mobile channel.

This study contributes to the technology affordance literature by offering empirical evidence of search constraint of mobile technologies in the context of e-commerce and demonstrating its time-varying impact on technology use. Another important argument of the literature is that the realization could be dynamic as user experience with technology accumulates [6] [18]. The positive and significant coefficients of the interaction terms between user's mobile transaction experience and the information-intensity measures indicate the learning process in the mobile channel.

This study also provides important managerial implications. It shows that e-market users are more likely to purchase information-intensive products through the PC channel, but this tendency has weakened as their mobile shopping experience accumulates. E-marketplace such as Amazon or Taobao could better capitalize on their mobile user bases by offering different goods according to each user's experience in the mobile channel. They could present less information-intensive products (e.g., toilet paper) to new mobile channel adopters, while more information-intensive products (e.g., travel packages) to experienced mobile users.

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REFERENCES

[1] Bang, Y., Lee, D.-J., Han, K., Hwang, M., & Ahn, J.-H. (2013) 'Channel capabilities, product characteristics, and impacts of mobile channel introduction', *Journal of Management Information Systems*, Vol. 30, No. 2, pp. 101-125.

[2] Chintagunta, P.K., Chu, J., & Cebollada, J. (2012) 'Quantifying transaction costs in online/off-Line grocery channel choice', *Marketing Science*, Vol. 31, No. 1, pp. 96-114.

[3] Choudhury, V. & Karahanna, E. (2008) 'The relative advantage of electronic channels: A multidimensional view', *MIS Quarterly*, Vol . 32, No. 1, pp. 179-200.

[4] Daft, R. L., & Lengel, R. H. (1986) 'Organizational information requirements, media richness and structural design', *Management Science*, Vol. 32, No. 5, pp. 554-571.

[5] Dennis, A. R., Fuller, R. M., & Valacich, J. S. (2008) 'Media, tasks, and communication processes: A theory of media synchronicity', *MIS Quarterly*, Vol. 32, No. 3, pp. 575-600.

[6] Faraj, S., & Azad, B., (2012) 'The materiality of technology: An affordance perspective', in Leonardi, P.M., Nardi, B.A., & Kallinikos, J. (Eds.), *Materiality and Organizing: Social Interaction in a Technological World*, Oxford University Press, pp. 237-258.

[7] Frambach, R.T., Roest, H.C., & Krishnan, T.V. (2007) 'The impact of consumer internet experience on channel preference and usage intentions across the different stages of the buying process', *Journal of Interactive Marketing*, Vol. 21, No. 2, pp. 26-41.

[8] Hu, J., Huhmann, B.A., & Hyman, M.R. (2007) 'The relationship between task complexity and information search: The role of self-efficacy', *Psychology & Marketing*, Vol. 24, No. 3, pp. 253-270.

[9] Huang, P., Lurie, N.H., & Mitra, S. (2009) 'Searching for experience on the web: An empirical examination of consumer behavior for search and experience goods', *Journal of Marketing*, Vol. 73, No. 2, pp. 55-69.

[10] Inman, J.J., Shankar, V., & Ferraro, R. (2004) 'The roles of channel-category associations and geodemographics in channel patronage', *Journal of Marketing*, Vol. 68, No. 2, pp. 51-71.
[11] Janiszewski, C. (1998) 'The influence of display characteristics on visual exploratory search behavior', *Journal of Consumer Research*, Vol. 25, No. 3, pp. 290-301.
[12] Kiel, G.C. & Layton, R.A. (1981) 'Dimensions of consumer information seeking behavior', *Journal of Marketing Research*, Vol. 18, No. 2, pp. 233-239.
[13] Kuruzovich, J., Viswanathan, S., Agarwal, R., Gosain, S., & Weitzman, S. (2008) 'Marketspace or marketplace? Online information search and channel outcomes in auto retailing', *Information Systems Research*, Vol. 19, No. 2, pp. 182-201.
[14] Leonardi, P.M. (2011) 'When flexible routines meet flexible technologies: Affordance, constraint, and the imbrication of human and material agencies', *MIS Quarterly*, Vol. 35, No. 1, pp. 147-167.
[15] Markus, M.L., & Silver, M.S. (2008) 'A foundation for the study of IT effects: A new look at desanctis and Poole's concepts of structural features and spirit', *Journal of the Association for Information Systems*, Vol. 9, No. 10, pp. 609-632.
[16] Orlikowski, W.J. (2010) 'The sociomateriality of organisational life: Considering technology in management research', *Cambridge Journal of Economics*, Vol, 34, No. 1, pp. 125-141.
[17] Thomas, J.S. & Sullivan, U.Y. (2005) 'Managing marketing communications with multichannel customers', *Journal of Marketing*, Vol. 69, No. 4, pp. 239-251.
[18] Treem, J. W., & Leonardi, P. M. (2012) 'Social media use in organizations: Exploring the affordances of visibility, editability, persistence, and association', *Communication Yearbook*, Vol. 36, pp. 143-189.
[19] Valentini, S., Montaguti, E., & Neslin, S.A. (2011) 'Decision process evolution in customer channel choice', *Journal of Marketing*, Vol. 75, No. 6, pp. 72-86.