Back to the future: Updating logistics customer service through green transportation

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Abstract

Building on Langley and Holcomb's (1992) elements of logistics customer value, we test for green transportation as an additional antecedent of logistics customer service. Two scenario-based experiments were conducted with distinct panels of online participants from the US and the UK, comprising 110 and 402 valid responses respectively. ANOVA was used in hypothesis testing. Results show that green transportation positively affects customer value, customer attitude toward firms and customer loyalty more than traditional transportation. Additionally, the findings indicate moderating effects of the source of energy used by vehicles (i.e. renewable *versus* non-renewable) and the environmental reputation of suppliers of transportation (i.e., positive *versus* negative) on the three explained variables considered. By focusing on green transportation, the impact of sustainable management on other components of logistics remain unexplored. Future research may extend the approach to areas such as green purchasing and green inventory management, among others. The study offers empirical evidence that shall justify the considerable investments logistics service providers make into the provision and the communication of using green transportation. The investigation contributes to a more comprehensive understanding on the nature and on the antecedents of logistics customer service. Moreover, through the demonstration of the effects of green transportation on that regard, we add to the literature on sustainable operations, particularly on its utilization as a source of value creation to firms.

Keywords: Green transportation, sustainable management, logistics service

Introduction

More than a business orientation, logistics has long been perceived as a value creation process (Rutner and Langley, 2000) and a source of competitive advantage (Morash *et al.*, 1996; Olavarrieta and Ellinger, 1997; Yeung *et al.*, 2006). In this sense, the literature has linked logistics performance (Bowersox *et al.*, 2002) to improved customer service

(Christopher, 1993) in a number of ways, particularly in the context of an increasing commoditization of goods (Woods, 1991). Positive outcomes such as augmented levels of customer satisfaction and loyalty (Daugherty *et al.*, 1998) would be common in that matter. Nevertheless, while firms' capacity to ensure traditional operational performance measures such as quality, dependability, speed and cost efficiency (Nakane, 1986; Ferdows and De Meyer, 1990) must still echo among customers, it is possible that new and perhaps more nuanced demands of society have still not been sufficiently treated.

The blooming of the environmental debate in the last decades, for instance, offers valuable opportunities for an update of the literature. Beyond objective concerns about the preservation of fauna and flora, from the 1970s on, sustainability has gradually become an important part of political rhetoric, supporting the actions and agendas of governments, groups and individuals (Dixon and Fallon, 1989). As the idea of saving the Earth became popular (Dean, 2007), moral and ethical dilemmas were imposed on different aspects of life (Emerich, 2011), with consumers progressively moving toward more sustainable demands (Mont and Plepys, 2008).

Aiming to offer additional comprehension on the effect of environmentally friendly operations on logistics service providers, the present work analyzes green transportation as a driver of logistics customer service generation. Building on Langley and Holcomb's (1992:1) perception that in logistics, "customer value can be created through product availability, timeliness and consistency of delivery and ease of placing orders, and other elements of customer service", we propose green transportation as an additional dimension on that matter. The objectives of our study may be represented, then, by the following research questions: (1) Does green transportation lead to enhanced logistics customer service? (2) Do factors such as the type of energy used and suppliers' environmental reputation influence such relation?

Literature Review

Logistics customer value and customer service

Traditionally, the Operations Management literature has pointed to the development of specific capabilities as vectors of value creation. Following the prosperity of Japanese automotive manufacturers in the 1970s and 1980s, for instance, performance measures around operational quality, dependability, speed and cost efficiency (Nakane, 1986; Ferdows and De Meyer, 1990) emerged as the main factors of operational success. Langley and Holcomb (1992) highlight the importance companies like Xerox and McDonalds accorded to some of these dimensions. The authors do however stress that specific elements of logistical service could also create significant value for customers. Accordingly, logistics customer value could be reached through the provision of adequate levels of product availability, through the timeliness and consistency of delivery and, along with other elements of customer service, the ease of placing orders.

The development of an eco-conscience among consumers

Direct and indirect sustainability related themes such as corporate social responsibility and ethics have been incorporated by companies as structural elements of their brand identities (Jardine, 2006), with marketers approaching the growing interest in environmental concerns as segmentation and targeting tools (Oates *et al.*, 2008). In reflex, and supported by a sense of urgency, companies were pressured to revisit and reengineer their production processes, as, to a large extent, corporate activity was pointed as one of the main drivers of the destruction of natural environments, pollution, and irresponsible consumption of resources (Jaggi and Freedman, 1992). In view of this increased eco-

conscience, it is possible that traditional logistics performance elements happen to be no longer enough to the provision of satisfactory levels of customer service.

Hypotheses of the study

H1: Green transportation positively affects customer value more than traditional transportation.

H2: Green transportation positively affects customer attitude toward the firm more than traditional transportation.

H3: Green transportation positively affects customer loyalty (recommend) more than traditional transportation.

H4: Customer value mediates the relationship between green transportation and customer loyalty (recommend).

H5: Customer attitude toward the firm mediates the relationship between green transportation and customer loyalty (recommend).

H6a: Customer value increases when renewable sources of fuel are used for green transportation.

H6b: Customer attitude toward the firm increases when renewable sources of fuel are used for green transportation.

H6c: Customer loyalty (recommend) increases when renewable sources of fuel are used for green transportation.

H7a: Customer value increases when the supplier is known for its positive environmental reputation.

H7b: Customer attitude toward the firm increases when the supplier is known for its positive environmental reputation.

H7c: Customer loyalty (recommend) increases when the supplier is known for its positive environmental reputation.

Research Method

Two scenario-based experiments were conducted to test the proposed hypotheses. This method has been widely employed in various B2C contexts for studying the relationship between the variations in a firm's strategies and the resulting emotional and behavioral reactions of customers (e.g. Palmatier *et al.*, 2009; Shin *et al.*, 2017). Using the B2C logistics service providers (LSPs) context, Study 1 examined the effect of four elements of customer logistics, including an added element of green transportation to the traditional three elements of customer logistics suggested by Langley and Holcomb (1992), on customer value, attitude toward the firm, and customer loyalty (recommend). Study 2 further investigated the moderating effects of the energy source and the supplier's environmental reputation, which are posited to heighten levels of customer value, attitude toward the firm, and customer loyalty (recommend).

Study 1

Research design and procedure

A total of 111 participants from the U.S. and U.K. were recruited through Prolific Academic (www.prolific.ac), a panel provider for online surveys and experiments. Our sample comprises 55 U.S. residents (49.5%) and 56 U.K. residents (50.5%), with 55.9% female, a median age of 35, and 89.2% Caucasian. Participants were randomly assigned to one of the two conditions: three customer logistics elements (product availability, ease of placing orders, timeliness and consistency of delivery) versus four elements (first three elements plus green transportation). This enabled us to compare the effects of traditional transportation and green transportation. We chose B2C logistics service providers as the

research context because these service providers are "significant actors in supply chains" (Forslund, 2012:297) who act as intermediaries between suppliers and customers (Hertz and Alfredsson, 2003). It was also assumed that a large number of participants would be familiar with and would have experienced the services provided by B2C logistics service providers.

Each participant received a short scenario description and a questionnaire. The scenario first introduced participants to a fictitious logistics service provider called ACE Logistics, which was described as UK-based and one of the biggest global logistics services companies serving both corporate and individual customers. All participants were asked to imagine that they want to use ACE Logistics to send a birthday gift to a friend who lives approximately 700 miles away. In both conditions, the same details were provided about ACE Logistics' services in terms of the three elements of customer logistics (i.e., product availability, ease of placing orders and timeliness and consistency of delivery). However, in the four-elements condition, participants were told that ACE Logistics makes ground deliveries using low- or zero-carbon-emission vehicles only, reducing the negative impact on the environment. Conversely, in the three-elements condition, they were told that ground deliveries are made using ordinary vehicles only, causing a negative impact on environment (See Appendix for complete details). After the participants read the scenarios, they completed a questionnaire that included items to measure the mediating and dependent variables, realism and manipulation checks, and demographic characteristics.

Manipulation and realism checks

We asked participants which type of transportation was being utilized for ground deliveries by ACE Logistics, with two responses: 1 = ordinary vehicles or 2 = low- to zero-carbon-emission vehicles. Following a data cleaning procedure adopted by Mikolon *et al.* (2015) and Albrecht *et al.* (2017), we removed seven participants who incorrectly identified the experimental conditions from the data set due to their incorrect response. This left a total of 104 participants.

For the remaining participants, the measures checking the use of traditional transportation, composed of three items (i.e. "ACE Logistics delivers using ordinary vehicles exclusively") were first reverse-coded so that higher scores represent green transportation, and then subjected to one-way analysis of variance (ANOVA). The means for green transportation were significantly higher in the four-elements condition than the three-elements condition, indicating that the manipulation worked as intended ($M_{\text{three elements}}$ = 1.87 vs. $M_{\text{four elements}}$ = 6.39, $F(1, 102) = 578.85$, $p = 0.00$). Furthermore, no significant mean differences were observed for the measures composed of three items checking product availability (i.e., "ACE Logistics offers the exact shipping service I needed"; $M_{\text{three elements}}$ = 6.34 vs. $M_{\text{four elements}}$ = 6.29, $F(1, 102) = 0.10$, *ns*), ease of placing orders (i.e., "ACE Logistics makes it easy to place an order."; $M_{\text{three elements}}$ = 6.38 vs. $M_{\text{four elements}}$ = 6.33, $F(1, 102) = 0.10$, *ns*), and timeliness and consistency of delivery (i.e., "ACE Logistics promises on-time delivery"; $M_{\text{three elements}}$ = 6.11 vs. $M_{\text{four elements}}$ = 6.33, $F(1, 102) = 1.94$, *ns*) between the three- and four-element conditions. Participants in Study 1 clearly evaluated the scenarios as realistic (M = 5.76 vs. 4 (the midpoint): t = 14.54, p = 0.00), believable (M = 5.77 vs. 4 (the midpoint): t = 14.93, p = 0.00), and likely (M = 5.79 vs. 4 (the midpoint): t = 15.25, p = 0.00).

1.1.1. Measurement validation

While we used established multi-item scales to measure customer value (Okada, 2005), customer attitude toward the firm (Hagtvedt and Patrick, 2008), and customer loyalty (recommend) (Lam *et al.*, 2004), manipulation checks for green transportation

were newly created for the purpose of this study. All measurement items were assessed with 7-point semantic differential and Likert-type scales. The confirmatory factor analysis (CFA) conducted with Lisrel 9.30 on the items representing the variables of interest revealed an acceptable fit with the data, $\chi^2/df = 1.60$, RMSEA = 0.08, SRMR = 0.02, CFI = 0.98, NNFI = 0.98, and IFI = 0.98. All scales exhibited convergent validity according to the factor loadings, Cronbach's α, composite reliability, and average variance extracted (AVE) values, which exceeded the common thresholds (see Table I). The results also supported discriminant validity; as can be seen in Table II, the correlations between variables were lower than the square root of AVE of each construct (Fornell and Larcker, 1981).

Table I. Items and Reliabilities (Study 1/Study 2)

Scale/items	Factor loadings	Cronbach's α	Composite reliability	AVE
Customer value (Okeda, 2005)		0.88/0.93	0.88/0.94	0.71/0.83
What is the value of the service provided by ACE Logistics?: Not at all valuable (1) - Extremely valuable (7)	0.88/0.92			
How well off would you be with the service provided by ACE Logistics?: Not at all well off (1) - Extremely well off (7)	0.75/0.88			
How happy would you be with the service provided by ACE Logistics?: Extremely unhappy (1) - Extremely happy (7)	0.89/0.93			
Customer attitude toward the firm (Hagtvedt and Patrick, 2008)		0.98/0.94	0.98/0.97	0.89/0.86
Extremely unfavorable (1) - Extremely favorable (7)	0.94/0.95			
Extremely negative (1) - Extremely positive (7)	0.96/0.95			
Extremely bad (1) - Extremely good (7)	0.96/0.94			
Extremely displeased (1) - Extremely pleased (7)	0.93/0.92			
Extremely unlikable (1) - Extremely likable (7)	0.93/0.88			
Customer Loyalty (Recommend)[a] (Lam et al. 2004)		0.94/0.97	0.95/0.95	0.85/0.85
I would say positive things about ACE Logistics to friends.	0.91/0.92			
I would recommend ACE Logistics to friends who seek my advice in finding logistics services.	0.95/0.94			
I would encourage friends to order delivery services from ACE Logistics.	0.91/0.91			

[a]Anchored by strongly disagree (1) to strongly agree (7)

Table II. Descriptive statistics and construct correlations for Study 1

Variable	Mean	SD	1	2	3
1. Customer value	6.11	0.91	**0.84**		
2. Customer attitude toward the firm	5.88	1.14	0.80*	**0.94**	
3. Customer loyalty (recommend)	5.78	1.20	0.76*	0.85*	**0.92**

n=104

* Correlation is significant at the 0.01 level (2-tailed).

Square root of the average variance explained (AVE) in boldface on the diagonal.

Hypothesis testing results

To test the role of green transportation in customer value (H1), customer attitude toward the firm (H2), and customer loyalty (recommend) (H3), we conducted a series of one-way ANOVAs with customer logistics strategies at two levels (three vs. four elements of customer logistics). As anticipated, the results show that participants rated customer value ($M_{\text{three elements}} = 5.82$ vs. $M_{\text{four elements}} = 6.36$, $F(1, 102) = 9.79$, $p < 0.01$), customer attitude

toward the firm ($M_{\text{three elements}} = 5.50$ vs. $M_{\text{four elements}} = 6.19$, $F(1, 102) = 10.32$, $p < 0.01$), and customer loyalty (recommend) ($M_{\text{three elements}} = 5.38$ vs. $M_{\text{four elements}} = 6.11$, $F(1, 102) = 10.42$, $p < 0.01$) higher in the four elements of customer logistics with green transportation than in the three elements of customer logistics with ordinary transportation conditions, supporting H1-H3.

Following Preacher and Hayes (2008), the indirect effects of green transportation on customer loyalty (recommend) mediated by customer value (H4) and customer attitude toward the firm (H5), respectively, were tested using bootstrapping. The results from the bootstrap estimation with 5,000 resamples were both significant at the 95% confidence level, confirming that, as predicted in H4 and H5, customer value (M = 0.52, SE = 0.19, confidence interval = 0.19, 0.95) and customer attitude (M = 0.61, SE = 0.22, confidence interval = 0.22, 1.09) mediates the influence of green transportation on customer loyalty (recommend).

Study 2

Research design and procedure

Study 2 was conducted to further examine the moderating roles of the energy source and the supplier's environmental reputation, which may leverage the impact of green transportation on customer value and customer attitude toward the firm and, ultimately, on customer loyalty (recommend). The scenarios in Study 2 utilized the same baseline scenarios and research context as in Study 1 and built additional stimuli to test the effects of moderators. The sample consisted of 204 U.S. participants, drawn from the same pool as in Study 1. To ensure that those who participated in Study 1 were excluded from participating in Study 2, we used a "previous studies" screener on Prolific (Bradley, 2017). Of the 204 participants, 50.8% were female, the median age was 33, and 75.2% were Caucasian. We assigned participants randomly to one of the four between-subjects treatment conditions. The scenario conditions manipulated participants' perceptions of the two factors that we hypothesize to influence the effect of green transportation on customer outcomes while keeping the green transportation activity constant: (1) the energy source (renewable vs. non-renewable) and (2) the supplier's environmental reputation (positive vs. negative).

In the renewable (non-renewable) energy source condition, the scenario indicated that the trucks used by ACE Logistics work on electric power generated by renewable (non-renewable) energy sources. In the positive (negative) supplier's environmental reputation condition, the participants were told that the manufacturer of the trucks ACE Logistics uses has a long history of manufacturing environmentally-friendly vehicles (was found guilty of manipulating CO_2 emission test results) and has been voted as one of the "Best (Worst) Companies for the Planet" for years. The complete details of the scenarios and manipulations are presented in the Appendix.

After the participants read the scenarios, they completed a questionnaire that included items to measure the mediating and dependent variables, realism and manipulation checks, and demographic characteristics.

Manipulation and realism checks

As in Study 1, we removed 15 responses of those who incorrectly identified the experimental conditions, leaving 189 valid responses for analyses. Of those participants who were subjected to the energy source conditions ($n = 93$), the measures checking the use of renewable energy, composed of three items (i.e. "ACE Logistics trucks use renewable energy sources") were subjected to ANOVA. The means for renewable energy were significantly higher in the renewable condition than the non-renewable energy

condition, indicating that the manipulation worked as intended ($M_{\text{non-renewable energy}} = 1.41$ vs. $M_{\text{renewable energy}} = 6.62$, $F(1, 91) = 1623.43$, $p = 0.00$).

In addition, for those participants who were subjected to the supplier's environmental reputation condition ($n = 93$), the measures checking the supplier's positive environmental reputation condition (composed of three items such as "ACE Logistics uses trucks produced by an automobile company that is known for manufacturing environmentally friendly vehicles") were subjected to ANOVA. The means for the supplier's positive environmental reputation were significantly higher in the supplier's positive environmental reputation condition than the supplier's negative environmental reputation condition, indicating that the manipulation worked as intended ($M_{\text{supplier's negative environmental reputation}} = 2.43$ vs. $M_{\text{supplier's positive environmental reputation}} = 6.61$, $F(1, 94) = 345.45$, $p = 0.00$). Thus, the results of the manipulation checks for each condition confirmed that the conditions demonstrated significant mean differences in the correct directions.

Participants in Study 2 also clearly evaluated the scenarios as realistic ($M = 5.71$ vs. 4 (the midpoint): $t = 19.08$, $p = 0.00$), believable ($M = 5.70$ vs. 4 (the midpoint): $t = 19.14$, $p = 0.00$), and likely ($M = 5.61$ vs. 4 (the midpoint): $t = 17.25$, $p = 0.00$).

1.1.2. Measurement validation

Study 2 used the same scales as in Study 1. In addition, we included manipulation checks of participants' perceptions of the type of energy used and the supplier's environmental reputation. The CFA conducted with Lisrel 9.30 on the items representing the variables of interest revealed a good fit with the data, $\chi^2/df = 1.51$, RMSEA = 0.05, SRMR = 0.02, CFI = 0.99, NNFI = 0.99, and IFI = 0.99. All scales exhibited convergent validity according to the factor loadings, Cronbach's α, composite reliability, and AVE values, which exceeded the common thresholds (see Table I). The results also supported discriminant validity; as can be seen in Table III, the correlations between variables were lower than the square root of AVE of each construct (Fornell and Larcker, 1981).

Table III. Descriptive statistics and construct correlations for Study 2

Variable	Mean	SD	1	2	3
1. Customer value	6.10	1.00	**0.91**		
2. Customer attitude toward the firm	5.91	1.14	0.77*	**0.93**	
3. Customer loyalty (recommend)	5.67	1.30	0.76*	0.77**	**0.92**

n=189

* Correlation is significant at the 0.01 level (2-tailed).

Square root of the average variance explained (AVE) in boldface on the diagonal.

Data analysis and results

We conducted a series of one-way ANOVAs to investigate the roles of moderating factors, the type of energy used and the supplier's environmental reputation that firms may use to leverage the impact of green transportation on customer value and customer attitude and, ultimately, customer loyalty (recommend). In H6, we hypothesized that customer value (H6a), customer attitude (H6b), and customer loyalty (recommend) (H6c) increase when renewable energy is used for green transportation. We find support for H6a - H6c as customer value (H6a; $M_{\text{non-renewable energy}} = 6.00$ vs. $M_{\text{renewable energy}} = 6.35$, $F(1, 91) = 4.61$, $p < 0.05$), customer attitude (H6b; $M_{\text{non-renewable energy}} = 5.51$ vs. $M_{\text{renewable energy}} = 6.20$, $F(1, 91) = 10.20$, $p < 0.01$), and customer loyalty (recommend) (H6c; $M_{\text{non-renewable energy}} = 5.50$ vs. $M_{\text{renewable energy}} = 5.96$, $F(1, 91) = 4.10$, $p < 0.05$) were higher for the renewable energy condition than the non-renewable condition.

We also predicted in H7 that customer value (H7a), customer attitude (H7b), and customer loyalty (recommend) (H7c) would increase when supplier is known for its

environmental reputation. We find support as customer value (H7a; $M_{\text{supplier's negative environmental reputation}} = 5.64$ vs. $M_{\text{supplier's positive environmental reputation}} = 6.36$, $F(1, 94) = 10.40$, $p < 0.01$), customer attitude (H7b; $M_{\text{supplier's negative environmental reputation}} = 5.53$ vs. $M_{\text{supplier's positive environmental reputation}} = 6.26$, $F(1, 94) = 10.56$, $p < 0.01$), and customer loyalty (H7c; $M_{\text{supplier's negative environmental reputation}} = 5.19$ vs. $M_{\text{supplier's positive environmental reputation}} = 5.93$, $F(1, 94) = 6.51$, $p < 0.05$) were greater for the supplier's positive environmental reputation condition compared to the supplier's negative environmental reputation condition.

Discussion and Implications

Beyond empirically testing and confirming Langley and Holcomb's (1992) perception of product availability, timeliness and consistency of delivery, and ease of placing orders as antecedents of logistics customer value, our results also provide empirical evidence for the positive relation of these conditions with supplementary dimensions of customer service, namely customer loyalty and customer attitude toward firms. When compared with traditional transportation, the adoption of green transportation enhances the effects in all dimensions (with mediating effects of customer value and attitude toward firms on customer loyalty), arguing for its additional customer service potential. Likewise, our study also advances the understanding of moderating factors such as the use of renewable sources of energy and the environmental reputation of suppliers in customer value and customer loyalty.

When it comes to the provision of logistics services, the adoption of environmental strategies may be particularly favorable in terms of both increasing operating margins and in the creation and management of positive environmental reputations (Fracarolli Nunes and Lee Park, 2017). While renewable energies must be more readily utilized in all means of door-to-door transportation, bicycles must be more easily employed for urban transportation, and more specifically, last-mile deliveries. The effect of the preference for suppliers counting on positive environmental reputations on customers' attitudes toward firms empirically demonstrates a case of supply chain reputational spillover. That contributes to the comprehension that supplier selection practices are relevant over and above the choice of partners presenting the lowest cost or the fastest service. Yet, from this viewpoint, unorthodox supply chain management practices are once more brought to the discussion as an alternative form firms must count on to create additional value. Therefore, the answer to our research questions (1) Does green transportation lead to enhanced logistics customer service? and (2) Do factors such as the type of energy used and suppliers' environmental reputation influence such relations? is yes, as our results support such conjectures.

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