International Journal of Gerontology Special Issue (2019) S45–S50
https://doi.org/10.6890/IJGE.201910/SP.0007

International Journal of Gerontology

journal homepage: http://www.sgecm.org.tw/ijge/

Special Issue

Using Kano Two-Dimensional Model to Analyze the Attributes of Rehabilitation Bus Service Quality for the Disabled

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ARTICLE INFO

Accepted 6 July 2019

Keywords:
elderly,
Kano model,
rehab bus,
service attribute,
disabled

SUMMARY

The Taiwanese population of disabled and elderly has grown considerably in recent years. The government has accordingly actively improved public transportation services to meet the growing demands of the elderly and the disabled. However, there is very limited knowledge on the essential service attributes that the disabled/elderly expect and desire. The purposes of this study are to investigate the services desired by the disabled/elderly and to classify the service attributes of rehab buses. The investigator created the questionnaire to collect the subjective assessment from the voluntary respondents in northern Taiwan. The questionnaire has two parts, the socioeconomic information of the respondents and their assessment of service requirement. There were 149 valid samples collected.
This study adopted Kano two-dimensional quality model to investigate the users' needs on twenty service attributes of rehab buses. The results indicated that 1) ease of reserving a ride, 2) compliance with safety regulation, 3) punctual pickup, 4) attentiveness and promptness of bus drivers were the most desired attributes. The least desired attribute was ridesharing arrangement, which, however, did not affect the satisfaction of the disabled/elderly respondent's with the service. It implies that the disabled/elderly did not resist sharing a ride with others. Ridesharing appears to be an effective measure to alleviate the problem of current supply of rehab buses.

1. Introduction

The statistics shows that the elderly population exceeds 14% of overall Taiwan population in 2018. The government predicts that by 2025 Taiwan will become a super-aged society with an elderly population accounting for more than 20% of national population. According to the Ministry of Health and Welfare (MOHW),[1] in 2016 the number of people with physical and mental disabilities in Taiwan exceeded 1.17 million, of which more than 460,000 were over 65 years old, accounting for more than 40% of the disabled population. The number of the disabled population over the age of 65 is expected to exceed 600,000 in 2020. A more convenient and accessible transportation service is therefore of great importance. In spite of their growing prevalence in cities around Taiwan, low-floor buses still pose serious challenges to wheelchair users, i.e., the disabled and the elderly. For them, rehab bus that provides door-to-door transit service is obviously a better choice.

However, while rehab bus service is essential for the wheelchair-dependent population, only a few studies investigated users' assessment of and satisfaction with the service quality. Most prior studies focused on the problem of insufficient supply without looking into the needs or expectations of rehab bus users. This study used the Kano two-dimensional quality model to investigate the service needs of the rehab bus users in Taiwan. The investigator divided the rehab bus users into two groups: the disabled and the elderly (hereinafter referred to as "the disabled/elderly") and their families and caregivers (referred to as "their families"). The main research objectives were to identify and classify the service attributes expected by rehab bus users and understand how the surveyed disabled/elderly and their families rate the identified attributes.

2. Materials and methods

2.1. Kano two-dimensional model

Kano et al.[2] proposed a two-dimensional quality model to identify the desired quality attributes of rehab bus service. According to Kano's model,[2] the horizontal axis represents the degree of presence (with/having/positive) of a quality attribute. The more moving to the right, the higher the degree of presence. Moving further to the right suggests a greater degree of presence, whereas further leftward movement indicates a higher level of absence (without/not having/negative). The vertical axis represents the level of customer satisfaction ranging from low to high. These coordinate axes of the Kano Model are used to identify the types of service quality attributes desirable to users and to filter out those failing to meet users' needs or have no value to users.[3]

The questionnaire was designed to incorporate both "functional" (with/presence/positive) and "dysfunctional" (without/absence/negative) questions. Therefore, there are two questions for

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each service attribute. Each question is given the following five options related to attribute presence/absence:
1: I dislike it that way.
2: I can live with it that way.
3: I am neutral.
4: It must be that way.
5: I like it that way.

Previous studies adopted different approaches to classify service quality attributes.[2,4,5] This study used the one proposed by Matzler and Hinterhunber[5] to classify service quality attributes into six categories, including "attractive", "one-dimensional", "must-be", "indifferent", "reverse", and "questionable" types of attributes as listed in Table 1. Categorizing a given service attribute is determined by the highest-rated options of the two (functional/positive and dysfunctional/negative) questions related to the attribute.[2,4,5] For example, a given service attribute is categorized as "one-dimensional" if "I dislike it that way" emerges to be the highest-rated option of its dysfunctional question (that is, respondents dislike it when the attribute is absent) and "I like it that way" the top option of its functional question (respondents like it if the attribute is present).

2.2 Indexes of customer satisfaction

As suggested by Matzler and Hinterhuber,[5] measuring quality indicators for fulfilled and unfulfilled service needs helps one understand the levels of customer satisfaction. Customer satisfaction coefficients can then be developed and applied to understand the influence of a service need on customer satisfaction when the service attribute is unknown or unclear, thereby helping a company develop effective strategies to improve customer satisfaction.

Berger et al.[6] improved Kano's model by introducing two customer satisfaction indexes (CSI) for a given service attribute: satisfaction increment index (SII) and dissatisfaction decrement index (DDI). A SII closer to 1 indicates a service attribute with a greater influence on customer satisfaction. On the other hand, a DDI closer to -1 points to a service attribute with a greater influence on customer dissatisfaction. Therefore, when the index score is close to 1 or -1, the service attribute of interest should be prioritized or strengthened. Equations (1) and (2) show how the two indicators are calculated.

$$\text{Satisfaction increment index (SII): } (A+O) / (A+O+M+I) \quad (1)$$

$$\text{Dissatisfaction decrement index (DDI): } (-1) \times (O+M) / (A+O+M+I) \quad (2)$$

where A, O, M, and I represent respectively the "attractive", "one-dimensional", "must-be", and "indifferent" categories of service quality. These four categories of service quality are defined as follows:

(1) Attractive quality. Customer needs marked with this quality have significant influence on how satisfied customers will be with a given product. Fulfillment of these needs leads to more than proportional satisfaction. If these needs are unfulfilled, there is no feeling of dissatisfaction.
(2) One-dimensional quality. Customer satisfaction is proportional to the level of fulfillment of customer needs with this quality. A higher level of fulfillment generates greater customer satisfaction.
(3) Must-be quality. If customer needs marked with this quality are unfulfilled, the customers will be extremely dissatisfied. As customers take these needs for granted, their fulfillment will not increase customer satisfaction.
(4) Indifferent quality. The fulfillment or un-fulfillment of service needs with this quality will not influence customer satisfaction nor dissatisfaction.

The axes of the "quality improvement matrix" diagram are the averages of SII and DDI. The horizontal axis represents the improvement of the satisfaction index; the vertical axis represents the reduction of dissatisfaction index. The first quadrant represents the improvement of the quality attributes exerting the greatest impact on customer satisfaction. The attributes in the second quadrant are mainly associated with "reducing customer dissatisfaction." Although the improvement of the attributes in the second-quadrant cannot increase customer satisfaction, it can effectively reduce customer dissatisfaction. The attributes in the third quadrant have less impact on increasing satisfaction or reducing dissatisfaction. The attributes in the fourth quadrant are more influential in improving customer satisfaction.

2.3. Questionnaire design

A number of prior studies had been conducted to examine the service quality attributes influencing customer satisfaction in the field of public transportation.[7–12] However, very few of them studied service quality of paratransit and rehab buses. This study adopted three reference sources for the design of questionnaire: 1) Gea's work on rehab buses,[13] 2) prior studies on public transportation, and 3) the service constructs of the SERVQUAL scale developed by Parasuraman, Zeithaml, and Berry.[14,15] More than twenty service attributes for measuring users' needs were included in the preliminary questionnaire. The questionnaire has two parts: assessment of service quality attributes and basic information. Each service attribute was assessed with a five-point scale in terms of "presence (with/fulfilled)" and "absence (without/ not fulfilled). The basic information included respondent types (the disabled/elderly and their families) and their experience of using rehab buses. No respondents' information obtained and recorded in this study could identify any individual identity.

2.4. Survey

A two-stage questionnaire survey, including a preliminary sur-

Table 1
Kano evaluation table.

Customer needs		Dysfunctional (without/absence/negative) question				
		Like	Must-be	Neutral	Live with	Dislike
Functional (with/presence/positive) question	Like	Q	A	A	A	O
	Must-be	R	I	I	I	M
	Neutral	R	I	I	I	M
	Live with	R	I	I	I	M
	Dislike	R	R	R	R	Q

A: Attractive; O: One-dimensional; M: Must-be; Q: Questionable; R: Reverse; I: Indifferent.

vey and a formal survey, was conducted by recruiting voluntary respondents to answer the questions. The questionnaire and study results did not include any identifiable private information.

2.4.1. Preliminary survey

A preliminary questionnaire was administrated to 38 voluntary rehab bus users to verify whether they were able to understand the positive and negative Kano questions well. To make sure the respondents fully understood the positive (with these evaluated attributes) and negative (without these evaluated attributes) questions, the investigator explained each question to each recruited user in an one-on-one interview. Results of the preliminary survey were used to modify the narratives and question of the questionnaire. Twenty service attributes of rehab bus were retained in the formal questionnaire.

2.4.2. Formal survey

The modified questionnaire was administered to the disabled/elderly and their families living in Northern Taiwan. The respondents were recruited on a voluntary basis from local hospitals and nursing homes between November 2016 and February 2017. A total of 157 respondents were interviewed and 149 valid samples were obtained, with an effective rate of 94.9%.

2.5. Statistical analysis

(1) The survey data were analyzed using nonparametric Mann-Whitney U test and Kruskal-Wallis test with the statistical significant level set at 5%.
(2) The Kano two-dimensional quality model was used to determine the category of each service attribute.
(3) The quality improvement indicators: satisfaction increment index (SII) and dissatisfaction decrement index (DDI) were adopted to develop the "quality improvement matrix" diagram. The located quadrant determined the improvement priority for each service attribute.

3. Results

3.1 Reliability analysis

This study conducted a reliability analysis for the following three constructs of service quality: "safety" (including 4 attributes, e.g. "good safety records"), "comfort" (including 8 attributes, e.g. "cleanness of bus interior") and "convenience and reliability" (including 8 attributes, e.g. "punctual pickup") with the measures of the Cronbach's α coefficients. All reliability reliability coefficients of the positive (with attributes) and negative (without attributes) questions of the three constructs exceeded 0.8, except for the negative (without attributes) questions of the "convenience and reliability" construct (as shown in Table 2). The deletion of "ridesharing arrangements" led to a significant increase in the reliability coefficients of both the positive (with) and the negative (without) questions (0.957 and 0.875 respectively). The results depicted that the measures of these three service quality constructs were considerably reliable and consistent.

3.2. Demographics and bus use characteristics

The 149 valid samples included 40 disabled and elderly respondents and 109 family members. The first part of the questionnaire focused on collecting the "basic information" of the respondents, including experience of using rehab buses. Because the assessed scores did not meet the normality assumptions, the nonparametric Mann-Whitney U tests and Kruskal-Wallis tests were used to examine whether the respondents' perceived needs were significantly different. Of the 149 valid samples, male (57%) respondents' needs were not statistically different from those of female (43%) respondents. The results of statistical analysis are summarized as follows:

(1) Experience of taking rehab buses: Based on the experience, the respondents were divided into two groups: 1) the first-time users (36%), 2) multiple-time users (64%). Statistically, there existed significant differences between these two groups except for "ridesharing arrangements." The analysis results indicated that bus use experience did affect users' expectations. Essentially, the first-time rehab bus users had higher expectations about service quality than multiple-time users.
(2) Frequency of use: The respondents were divided into two groups based on frequency of bus use: 1) 1–2 times per month (74%), 2) more than two times per month (26%). Statistically, these two groups of respondents reported significant differences in "quietness on board," "dress of bus driver," "provision of healthcare magazines on board," "comfortable temperature on board," "good safety records," and "comfortable seating space," suggesting that frequent users seemed to have more rigorous demands for quality of rehab bus service.

3.3. Scores of the service attributes

Table 3 shows the average scores rated by the disabled/elderly and their families in response to the positive and negative questions of the service attributes. For positive (with attribute) questions, the highest-rated (the most desired) service attribute for the disabled/elderly was "ease of reserving a ride," while the lowest-rated (the least desired) was "ridesharing arrangements." For negative (without attribute) question, the highest-rated attribute (the least expected) was "ridesharing arrangements." The lowest-rated (the most expected) attributes were "polite bus drivers" and "ease of reserving a ride." For the family respondents, the highest-rated service attribute for positive questions was "compliance with safety regulations"; the lowest-rated went to "ridesharing arrangements." For negative questions, the lowest- and highest-rated attributes were respectively "ease of reserving a ride" and "ridesharing arrangements.

3.4. Classification of service attributes

The studied service attributes of rehab buses were classified into five service categories: attractive, one-dimensional, must-be, indifferent, and reverse. Essentially, the respondents considered "quick response to customer complaints," "different charge depending on disable levels," and "prioritized reservation service by disability levels" attractive attributes. The disabled/elderly perceived "smooth ride," "quietness on board," and "dress of bus drivers" must-be attributes, which were regarded by their families as indifferent attributes. Also to be noted is that "ridesharing arrangements" emerged to be an indifferent attribute to the disabled/elderly and an

Table 2
Reliability analysis for service constructs.

Quality of service construct	With attributes	Without attributes
Safety (4)	0.831	0.824
Comfort (8)	0.899	0.890
Convenience and reliability (8)	0.829 (0.957*)	0.677 (0.875*)

Note. * Reliability with the "ridesharing" attribute excluded.

Table 3
The average satisfaction scores of service attributes.

Service attributes	The disabled/elderly		Their families	
	With	Without	With	Without
Cleanness of bus interior	4.10	1.43	3.89	1.61
Compliance with safety regulations	4.80	1.28	4.52	1.57
Comfortable temperature on board	4.03	2.05	3.89	2.17
Comfortable seating space	3.90	2.20	3.85	2.21
Smooth ride	4.13	1.48	4.01	1.71
Quietness on board	4.25	1.43	4.06	1.68
Polite bus drivers	4.45	1.23	4.39	1.73
Dress of bus drivers	4.08	1.45	3.83	1.71
Attentiveness and promptness of bus drivers	4.78	1.35	4.48	1.75
Provision of health-care magazines on board	3.58	2.53	3.69	2.39
Punctual pickup	4.83	1.30	4.43	1.70
Punctual arrival	4.80	1.30	4.42	1.70
Bus operator image	3.95	2.13	3.92	2.28
Good safety records	4.18	1.85	4.17	2.06
Ridesharing arrangements	2.05	3.85	2.20	3.72
Good customer complaint service	4.15	2.05	4.06	2.10
Quick response to customer complaints	4.58	1.95	4.40	2.19
Ease of reserving a ride	4.85	1.23	4.50	1.51
Different charge depending on disability levels	4.68	1.95	4.39	2.14
Prioritized reservation service by disability levels	4.75	1.93	4.40	2.10
Average	4.25	1.80	4.08	2.00

inverse attribute to their families.

3.5. Satisfaction and dissatisfaction index of service attributes

Table 4 summarizes the satisfaction index (SII) and dissatisfaction index (DDI) of the disabled/elderly and their family respondents. The average SII of the disabled/elderly was higher than that of their families, suggesting that the disabled/elderly were more likely to feel satisfied with the improvement of the studied service attributes than their families. The average DDI of the disabled/elderly was lower than that of their family. It implies that the disabled/elderly were more likely to feel less dissatisfied with the improvement of the service attributes than their families.

Table 5 shows the the classification and quadrant location of the studied service attributes according to the responses from the disabled/elderly and their families. The origins were based on the averages of (0.44, -0.40) and (0.37, -0.30) for the disabled/elderly and their family respondents, respectively. The attributes for these two respondent groups appeared to fall into the same quadrants, implying that the priorities of service improvement were identical for the disabled/elderly and their families.

The attributes in the first quadrant were related to “performance” needs as improvement of these attributes could be expected to increase user satisfaction. The attributes in the second quadrant were related to basic (or “threshold”) needs expected by

Table 4
The SII and DDI of service attributes.

Service attributes	The disabled/elderly		Their families	
	SII	DDI	SII	DDI
Cleanness of bus interior	0.25	-0.60	0.16	-0.54
Compliance with safety regulations	0.83	-0.75	0.66	-0.58
Comfortable temperature on board	0.13	-0.05	0.19	-0.11
Comfortable seating space	0.18	-0.08	0.20	-0.10
Smooth ride	0.20	-0.55	0.17	-0.45
Quietness on board	0.28	-0.65	0.23	-0.50
Polite bus drivers	0.53	-0.80	0.53	-0.42
Dress of bus drivers	0.20	-0.60	0.17	-0.45
Attentiveness and promptness of bus drivers	0.80	-0.65	0.63	-0.42
Provision of health-care magazines on board	0.13	0.00	0.20	-0.06
Punctual pickup	0.85	-0.73	0.60	-0.48
Punctual arrival	0.83	-0.73	0.57	-0.47
Bus operator image	0.13	-0.05	0.22	-0.06
Good safety records	0.23	-0.18	0.33	-0.11
Ridesharing arrangements	0.09	-0.09	0.07	-0.11
Good customer service	0.18	-0.18	0.22	-0.13
Quick response to customer complaints	0.60	-0.15	0.58	-0.12
Ease of reserving a ride	0.88	-0.80	0.61	-0.59
Different charge depending on disability levels	0.70	-0.18	0.56	-0.12
Prioritized reservation service by disability levels	0.78	-0.13	0.56	-0.09
Average	0.44	-0.40	0.37	-0.30

Table 5
Characteristics of attributes for two groups of respondents.

Service attributes	The disabled/elderly	Their families	Quadrant
Compliance with safety regulations	O	O	1
Polite bus drivers	O	O	1
Attentiveness and promptness of bus drivers	O	O	1
Punctual pickup	O	O	1
Punctual arrival	O	O	1
Ease of reserving a ride	O	O	1
Cleanness of bus interior	M	M	2
Smooth ride	M	I	2
Quietness on board	M	I	2
Dress of bus drivers	M	I	2
Comfortable temperature on board	I	I	3
Comfortable seating space	I	I	3
Provision of health-care magazines on board	I	I	3
Bus operator image	I	I	3
Good safety records	I	I	3
Good customer service	I	I	3
Ridesharing arrangements	I	R	3
Quick response to customer complaints	A	A	4
Different charge depending on disability levels	A	A	4
Prioritized reservation service by disability levels	A	A	4

Note: A: attractive requirement; O: one-dimensional requirement; M: must-be requirement; I: indifferent requirement; R: reverse requirement.

users. The attributes in the third quadrant were needs whose presence or absence failed to affect satisfaction to most users. Customer satisfaction remained neutral under either circumstance for the third-quadrant attributes. The improvement of the attributes in the fourth quadrant (attributes related to "excitement" needs) would significantly increase user satisfaction. All the three 4th-quadrant service attributes listed above were crucial to the success of rehab bus operators.

4. Conclusions

The study, using the Kano two-dimensional quality model, aimed at identifying the service needs affecting the satisfaction of rehab bus users in Taiwan. A two-stage questionnaire survey was conducted to collect rehab bus users' opinions, including the primary users (the disabled/elderly) and their families. As indicated by the survey results, the subjective needs or the desired service attributes of the two respondent groups were identical. Both groups of respondents considered the attributes of 1) cleanness of bus interior, 2) smooth ride, 3) quietness on board, and 4) dress of bus drivers to be basic needs. The service attributes of 1) compliance with safety regulations, 2) polite bus drivers, 3) attentiveness and promptness of bus drivers, 4) punctual pickup, 5) punctual arrival, 6) ease of reserving a ride were "performance" attributes whose presence was expected to boost user satisfaction. Moreover, quick response to customer complaints, different charge depending on disability level, and quietness on board were the so-called "excitement" needs which went beyond users' expectation to significantly increase satisfaction.

Minor differences, however, did exist between the service needs of the disabled/elderly and those of their families. According to the SII and DDI indicators, the disabled/elderly respondents regarded 1) ease of reserving a ride, 2) punctual pickup, 3) compliance with safety regulations, 4) punctual arrival, and 5) attentiveness and promptness of bus drivers as the most required attributes. Their families, on the other hand, found the most needed attributes in 1) compliance with safety regulations, 2) attentiveness and promptness of bus drivers, 3) ease of reserving a ride, 4) punctual pickup, and 5) quick response to customer complaints. The differences between these two groups of respondents implied that ease of reserving a ride and compliance with safety regulations were users' most desired needs.

While considered by both groups of respondents to be the least desired needs, ridesharing arrangement was a reverse need to the family respondents and an indifferent need to the disabled/elderly respondents. That is, sharing a ride with others tended to reduce satisfaction for the family respondents but would not affect satisfaction for the disabled/elderly respondents. It implies that the disabled/elderly did not resist sharing a ride with other passengers, which can be an effective measure to alleviate the current short supply of rehab buses in Taiwan.

Acknowledgements

Special thanks to Mr. Y.W. Yeh for his assistance in questionnaire survey.

References

1. Department of Statistics, Ministry of Health and Welfare, R.O.C.(Taiwan). *Report of Disabled People's Living Condition and Demand Survey 2016*. Taipei, Taiwan: Ministry of Health and Welfare (Taiwan, ROC); 2016. Available at https://www.mohw.gov.tw/dl-44919-970c0b0b-c054-4de5-943f-cf156cc42b30.html. Accessed April 30, 2017.
2. Kano N, Seraku N, Takahshi F, et al. Attractive quality and must-be quality. *J. Jpn. Soc. Qual. Control.* 1984;41(2):39–48.
3. Mkpojiogu EOC, Hashim NL. Understanding the relationship between Kano model's customer satisfaction scores and self-stated requirements importance. *Springerplus*. 2016;5:197.
4. Schvaneveldt SJ, Enkawa T, Miyakawa M. Consumer evaluation perspectives of service quality: Evaluation factors and two-way model of quality. *Total Qual. Manag.* 1991;2(2):149–162.
5. Matzler K, Hinterhuber HH. How to make product development projects more successful by integrating Kano's model of customer satisfaction into quality function deployment. *Technovation.* 1998;18(1):25–38.
6. Berger C, Blauth R, Boger D, et al. Kano's method for understanding customer-defined quality. *CQM Journal*. 1993;2(4):3–36.
7. Hu KC, Jen W. Passengers' perceived service quality of city buses in Taipei: Scale development and measurement. *Transport Rev.* 2006;26(5):645–

662.
8. Barabino B, Deiana E, Tilocca P. Measuring service quality in urban bus transport: A modified SERVQUAL approach. *IJQSS*. 2012;4(3):238–252.
9. Islam R, Chowdhury MS, Sarker MS, et al. Measuring customer's satisfaction on bus transportation. *Am. J. Econ. Busi. Adm.* 2014;6(1): 34–41.
10. Olivková I. Evaluation of quality public transport criteria in terms of passenger satisfaction. *Transp. Telecom. J.* 2016;17(1):18–27.
11. Morton C, Caulfield B, Anable J. Customer perceptions of quality of service in public transport: Evidence for bus transit in Scotland. *Case Stu. Transp. Policy.* 2016;4(3):199–207.
12. Weng J, Di X, Wang C, et al. A bus service evaluation method from passenger's perspective based on satisfaction surveys: A case study of Beijing, China. *Sustainability*. 2018;10(8):2723.
13. Gea RK. *Performance evaluation of handicap bus operation*. Master thesis. Taipei, Taiwan, ROC: National Taiwan University; 2014.
14. Parasuraman A, Zeithaml VA, Berry LL. SERVQUAL: A multiple item scale for measuring consumer perceptions of service quality. *J. Retail.* 1988; 64(1):12–40.
15. Parasuraman A, Zeithaml VA, Berry LL. Refinement and reassessment of the SERVQUAL scale. *J. Retail.* 1991;67(4):420–450.