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# Bowing with a trunk flexion of 90°: Perspectives on consumers and service personnel

Yi-Lang Chen*, Lan-Shin Huang, Ling-Wei Peng, Liang-Jie Shi

*Department of Industrial Engineering and Management, Ming Chi University of Technology, New Taipei 24301, Taiwan*

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ABSTRACT

In this study, we analyzed 100 questionnaire responses to determine consumer conceptions of service personnel bowing as a gesture of politeness. In addition, 12 female participants demonstrate five distinct degrees of bowing by bending their trunk 30°, 45°, 60°, and 90° from an upright position; their spinal curvature and trunk muscle activations were measured. The results showed that most respondents believed that bowing at 30° was the most satisfactory angle, followed by 45°. Bowing at 45° or 60° caused the survey respondents to feel honored, whereas bowing at 90° induced feelings of surprise and novelty; however, this angle produced the lowest proportion level of agreements on the items at ease, necessary, and appropriate among the 100 respondents. When the 12 participants bowed at an angle ≤60°, their spinal posture became increasingly kyphotic, and their muscle activations became more pronounced. Myoelectric silencing of the erector spinae was observed when the participants bowed at 90°, which can increase the risk of low back injury. These findings provide service industries with a reference for the design of service encounters.

*Relevance to industry:* Bowing has traditionally signified politeness and respect in many countries. However, whether bowing at a greater trunk flexion actually satisfies customers remains unclear. Findings from this study clarify the customer perceptions and body loads of service personnel when bowing at various trunk positions. The extreme bowing postures (e.g., 90° trunk flexion) should be avoided.



## 1. Introduction

Traditionally, service industries have emphasized enhancing the quality of service encounters to ensure customer satisfaction (Bitner et al., 1994). In Eastern cultures, particularly in China and Japan, bowing has traditionally signified politeness and respect. Moreover, bowing at greater trunk flexion angles enhances customer perceptions of care and respect, thereby indirectly enhancing the effectiveness of service encounters (Lai, 2009).

Recently, a restaurant chain in Taiwan implemented a service policy requiring service personnel to bow at 90° when arriving at and leaving tables, as well as at the reception gate. This gesture was intended to increase customers' sense of feeling honored, which was established as a unique service feature of the company. This successful practice has been widely discussed and imitated by other restaurants. However, the policy requires service personnel to bow at 90° over 500 times on a busy day. Doing so requires them to extend their cervical spine for approximately 5 s while maintaining eye contact with a customer. Whether this angle of bowing is acceptable to service personnel or appropriate for customers has been debated. An investigation of bowing at 90° trunk flexion should involve consideration of the health of the service personnel.

Customer service personnel have special demands placed on them related to serving food to customers. Numerous factors affecting service personnel have traditionally been associated with musculoskeletal disorders. These factors include lifting and carrying heavy objects, maintaining awkward postures (e.g., bending forward and to the side), overextending their reach, and having to stand for prolonged periods. Wills (2013) observed that the body regions most frequently reported by service personnel as causing discomfort at the end of their shift were the upper back (55%), neck (45%), and lower back (50%) regions. These results are similar to the findings of Chyuan et al. (2004), Dempsey and Filiaggi (2006), and Lee et al. (2013). Previous research has shown that maintaining an

* Corresponding author. Department of Industrial Engineering and Management, Ming Chi University of Technology, 84, Gungjuan Rd., Taishan Dist., New Taipei 24301, Taiwan. Tel.: +886 2 29089899x3103; fax: +886 2 29085900.
*E-mail address:* ylchen@mail.mcut.edu.tw (Y.-L. Chen).

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unfavorable posture for prolonged periods increases the risk of developing low back pain (LBP; Bernard, 1997). Epidemiological studies have shown that activities involving repetitious bending are associated with an increased risk of developing LBP (Xu et al., 1997). Therefore, understanding whether bowing at 90° could cause low back injury in service personnel is crucial.

Bowing involves flexing the trunk forward. Several studies on trunk flexion and related spinal movements have shown that the lumbar flexion moment can be estimated by altering the moment arms of various body parts (DeLitto and Rose, 1992; Holmes et al., 1992). In general, the spine is subjected to an increased load when its curvature is far from its normal position (Wilson, 1969). McGill and Kippers (1994) reported apparent myoelectric silencing of the low back muscles (i.e., flexion-relaxation phenomenon; FRP) during a standing-to-full-trunk-flexion maneuver. Solomonow et al. (2003) hypothesized that the supporting role of the low back muscles (i.e., muscle contraction) is inhibited during full trunk flexion because of the reflexogenic stimulation of stretch receptors in passive structures, specifically, the posterior spinal ligaments. However, few studies have examined how bowing with a trunk flexion of 90° affect the occupational health of service personnel.

Radiography is the most accurate method for measuring spinal curvature (Chen, 2000; De Carvalho and Callaghan, 2012). However, this technique has rarely been used for systematic evaluations because of concerns regarding radiation exposure. Several studies have used skin-surface stick markers to assess the vertebral inclination at various trunk positions (Chaffin et al., 1972; Anderson et al., 1986; Chen and Lee, 1997). Chaffin et al. (1972) argued that using spinal markers in the lumbar region to estimate vertebral orientation was a plausible alternative to using radiographic data, although Burdett et al. (1986) and Chen and Lee (1997) have presented conflicting results. Chen and Lee (1997) developed a simple, noninvasive method for using skin-surface markers on a rigid surface to predict the internal vertebral angle along the sagittal plane. Moreover, these models have been adopted to evaluate the trunk flexion and lumbosacral angles (LSAs) of cyclists (Chen and Liu, 2014).

We hypothesized that there is an optimal bowing angle and that a trade-off can be achieved between honoring customers and preventing spinal stress to service personnel. This study surveyed customers to determine their perceptions and feelings regarding various angles of trunk flexion, especially related to customer service personnel bowing as a sign of respect. In addition, an experiment was conducted to examine the changes in spinal curvature and trunk muscle activations at five bowing angles, ranging from an upright posture to a bowing angle of 90°.

## 2. Methods

We analyzed 100 valid questionnaire responses to evaluate consumer perceptions regarding specific degrees of trunk flexion during bowing. Twelve female participants demonstrated varying degrees of bowing by bending their trunk by 30°, 45°, 60°, and 90° from an initial upright position, and their spinal curvature and trunk-muscle activation were measured. The study protocol was approved by the Ethics Committee at Chang Gung Memorial Hospital, Taiwan, and informed consent was obtained from all respondents and participants according to the committee's regulations.

### 2.1. Consumer perception survey

#### 2.1.1. Questionnaire implementation

We used a total of 122 questionnaires to collect data on consumer perceptions regarding various degrees of trunk flexion during bowing. The questionnaires were administered through individual face-to-face interviews. To prevent inconsistent interpretations of bowing angles, respondents were included in this study only if they had visited a restaurant where employees were required to bow at 90°. A convenience sampling method was employed, and potential candidates were approached on the streets of Taipei City for prescreening. After excluding incomplete and ineffective questionnaires, 100 valid responses remained, constituting an effective response rate of 82%.

The questionnaire comprised two sections (see the Appendix). The first section collected basic demographic information, including gender, age, marital status, occupation, education level, and monthly income. The second section contained seven semantic, differential questions for respondents to indicate to which question items they most agreed regarding the five bowing angles, namely 0°, 30°, 45°, 60°, and 90°. We divided the trunk flexion degrees ranging from upright to 90° into 30° increments, and a 45° flexion was used to represent a half-trunk flexion, because this is a typical bowing angle in Taiwan. We confirmed the content validity of the survey by conducting a pilot study and consulting with three marketing experts. To enhance the validity of the results, we provided photographs of people bowing at the five angles to supplement the survey (see the Appendix).

#### 2.1.2. Survey reliability

Table 1 shows the results regarding questionnaire reliability. Typically, constructs yielding a Cronbach α value below 0.35 indicated low reliability and were rejected, whereas a value over 0.7 indicated high reliability. All questionnaire items in this study yielded reliability values exceeding 0.8, indicating high reliability and internal consistency concerning the agreement among respondents regarding the question items in relation to various bowing angles.

#### 2.1.3. Survey criterion-related validity

For the analysis of validity, the questionnaire survey was assessed based on the criterion of overall satisfaction (Question 7). Based on this criterion, the chi-squared test results revealed significant correlations for most questions ($p < 0.001$), and only Question 6 (novelty) yielded a nonsignificant correlation. Thus, the results showed that, aside from Question 6, all questions directly explained overall satisfaction (Question 7).

### 2.2. Simulated bowing experiments

#### 2.2.1. Participants

We recruited 12 female university students aged 18–21 years to participate in the test. The participants' mean (standard deviation, SD) age, height, and body mass were 19.4 (0.7) years, 159.0 (4.9) cm, and 47.4 (5.9) kg, respectively. No participant reported a history of musculoskeletal injury or pain, with particular emphasis on LBP. All of the participants had worked as part-time employees in restaurants for at least 2 months, although none of them had worked in a

**Table 1**
Internal consistency of survey questions in the questionnaire.

| Questions | Cronbach's α |
|---|---|
| 1. Bowing at this angle makes me feel at ease. | 0.835 |
| 2. I feel that bowing at this angle is necessary. | 0.828 |
| 3. I feel that bowing at this angle is a pleasant surprise. | 0.837 |
| 4. Bowing at this angle makes me feel honored. | 0.848 |
| 5. I feel that bowing at this angle is appropriate. | 0.826 |
| 6. I feel that bowing at this angle is novel. | 0.862 |
| 7. Overall, I am satisfied when receiving a bow at this angle. | 0.816 |