

A holistic approach to manage environmental quality by using the Kano model and social cognitive theory

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Abstract

Since its first proposition in 1984, the Kano model has been used extensively in a variety of contexts within industries and academic research demonstrating its wide applicability. The Kano model allows for describing the relationship between an objective aspect and a subjective aspect. Yet is this relevant for environmental quality as well? In this study, we explore the cases where the Kano model is used for assessing environmental quality and its perception by consumers and identify the potential influencing factors for its application with this respect. We find that the Kano model can serve as an effective tool for converging towards environmental quality and sustainability by indicating the direction from a social and behavioral choice perspective. We propose an integration of the Kano model with Bandura's triangle (a concept of the social cognitive theory) to create an instrument for driving change of customer attitude and behavior via changing the perception of environmental quality.

KEYWORDS

environmental policy, perceived quality, quality attributes, social behavior, sustainable development, theory of attractive quality, theory of transforming well-being

1 | INTRODUCTION

A customer is at the center of quality management, as well as the development and delivery of attractive products and services of high quality are to this customer. Moreover, quality management deals with the customer's role in understanding what quality really is (Witell, Löfgren, & Dahlgaard, 2013). Inspired by the Herzberg's motivator-hygiene theory, Kano, Seraku, Takahashi, and Tsuji (1984) proposed the theory of attractive quality intended to better explain aspects of how customers perceive and evaluate quality attributes.

Since its first proposition, the Kano model has been applied for a wide variety of products, services, and research purposes. For

example, examination of customers' perception of packaging attributes (Löfgren, Witell, & Gustafsson, 2011), evaluation of service quality for mobile phones (Hsu, Chang, Wang, & Lin, 2007), determination of characteristics of e-shopping malls (Oh, Yoon, & Park, 2012), and even integration into architectural design (Ek & Çıkiş, 2015). As found by Luor, Lu, Chien, and Wu (2012), the number of studies on quality management that use the Kano model has vastly increased since the end of the 1990s and still continues to increase. Traditionally, the Kano model has been used in product development and creation of attractive quality, including studies on conceptual design to improve product's life cycle (Hassan et al., 2017) and perception of product's end-of-life scenarios and disposal methods (Atlason,

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Giacalone, & Parajuly, 2017). Yet there are also some “untraditional” applications, for example, in the assessment of urban soundscape (Jennings & Cain, 2013).

The aim of the research is to review how the Kano model has been used for assessing environmental quality and perception of environmental quality by consumers so far and next, to discuss the extension of the application of the Kano model with the concept of social cognitive theory—Bandura’s triangle. This extended Kano–Bandura’s model could create products and services that trigger sustainable social behavior and promote environmental quality.

Environmental quality is defined as “a measure of environmental condition relative to the requirements of one or more species or to any human need or purpose” (Johnson et al., 1997). In other words, it is a set of environmental aspects that affect organisms in their natural environment, such as air quality, surface water quality, drinking water quality, soil fertility, domestic and industrial pollution, overpopulation, and noise. Yet another, more sophisticated, meaning deals with the perceived environment, that is, the material and immaterial qualities (attributes) of man-made built and natural environment that support social and cultural structures of a specific group of people and hence provide them satisfaction with the physical settings. Additionally, products and services provided and used within these physical settings play a significant role as they may have a positive or negative effect on the experience of the perception. For example, installation of a water treatment system may significantly improve the perception of an area with otherwise poor water quality. Also, the industry recognizes the need for developing sustainable products as these products are perceived by end user as of higher value (Dace, Bazbauers, Berzina, & Davidsen, 2014). The specific attributes of environmental quality represent the preferences of an individual or a group of people. Thus, understanding these preferences is important for designing products and services that shape environmental quality.

We believe the Kano model might serve as a valuable tool in converging products and services towards sustainable social behavior. And vice versa, individual and social behavior can be directed towards sustainability by developing physical settings, products, and services that achieve specific criteria of perceived environmental quality, hence people satisfaction with their environment.

In this paper, we discuss the methodology of the Kano model in Section 2 and the model’s advantages and disadvantages in Section 3. Then in Section 4, we construct a search algorithm, and in Sections 5 and 6, we analyze the reviewed studies where attributes of environmental quality have been assessed by using the Kano model alone or integrated with other tools. Here, Section 5 discusses the use of exclusively the Kano model for various environmental quality management issues. Next, we also wanted to have a separate section that describes only emerging use of the Kano model together with other tools; therefore, we divided Sections 5 and 6 into two separate parts. Finally, in Section 7, we look at how the Kano model can be extended with Bandura’s triangle to create products and services that trigger sustainable social behavior and promote environmental quality. Section 7 is based on our expertise and knowledge, where we extended current

understanding about the Kano model and the use of the Kano model by proposing to link this model with social behavior tools. Section 7 is our addition to current scientific knowledge of such tools.

2 | BACKGROUND OF THE KANO MODEL

The theory of attractive quality proposes a methodology for describing the relationship between an objective aspect (as physical sufficiency) and a subjective aspect (as customer satisfaction; Kano, 2001). As a result, the relationship or the attributes are translated into five categories of perceived quality: attractive quality (A), must-be quality (M), one-dimensional quality (O), reverse quality (R), and indifferent quality (I; see Figure 1; Löfgren et al., 2011).

The categories of perceived quality are based on two feelings of customers, namely, a feeling experienced when a product has the attribute and a feeling when a product does not have the attribute (Finster, Eagan, & Hussey, 2001), resulting as satisfaction, dissatisfaction, or indifference. The relationship between various quality attributes is nonlinear. In addition, attributes are dynamic—the perception of an attribute by customers will change over time. The attribute can change, for example, from being satisfier (being exciting) to dissatisfier (being expected by default), because once introduced, this attribute initially being exciting will soon be imitated by competitors and expected by customers from every provider (Kano, 2001; Min, Yun, & Geum, 2018; Shahin & Zairi, 2009; see Figure 2). For example, after touchscreen was introduced to a phone by Apple Inc., it was expected in all other smartphones ever followed.

Finally, the Kano model includes a step-by-step methodology that can be used by company managers, city developers, organizations, and so forth to understand and classify various quality attributes of their products and services (Löfgren et al., 2011). The methodology uses a structured questionnaire that consists of pairs of questions for each attribute of the specific product or service. In each pair, the first question asks how a customer would feel if an attribute is present or fulfilled (functional question; see Figure 3 under survey questions), whereas the second question asks about the customer’s feelings in the case of absence or nonfulfillment of the attribute (dysfunctional question). Further, the data are analyzed using an evaluation table (see Figure 3 survey analysis) that results in the categorization of the attributes for each respondent (see Figure 3 conclusion). Finally, the frequencies of the correspondent categorizations are used to find the final classification of the perceived quality of an attribute (Mikulic & Prebežac, 2011). For company managers or researchers, a comprehensive step-by-step guide, sometimes with ready-to-use



FIGURE 1 The concept of the theory of attractive quality

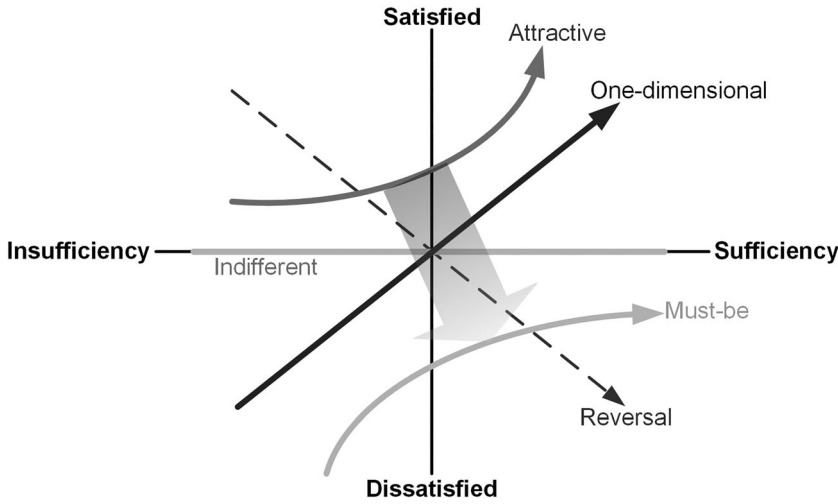


FIGURE 2 The nonlinear relationship of the categories of perceived quality (according to Chen & Chuang, 2008) and their dynamic nature (indicated by the bold arrow)

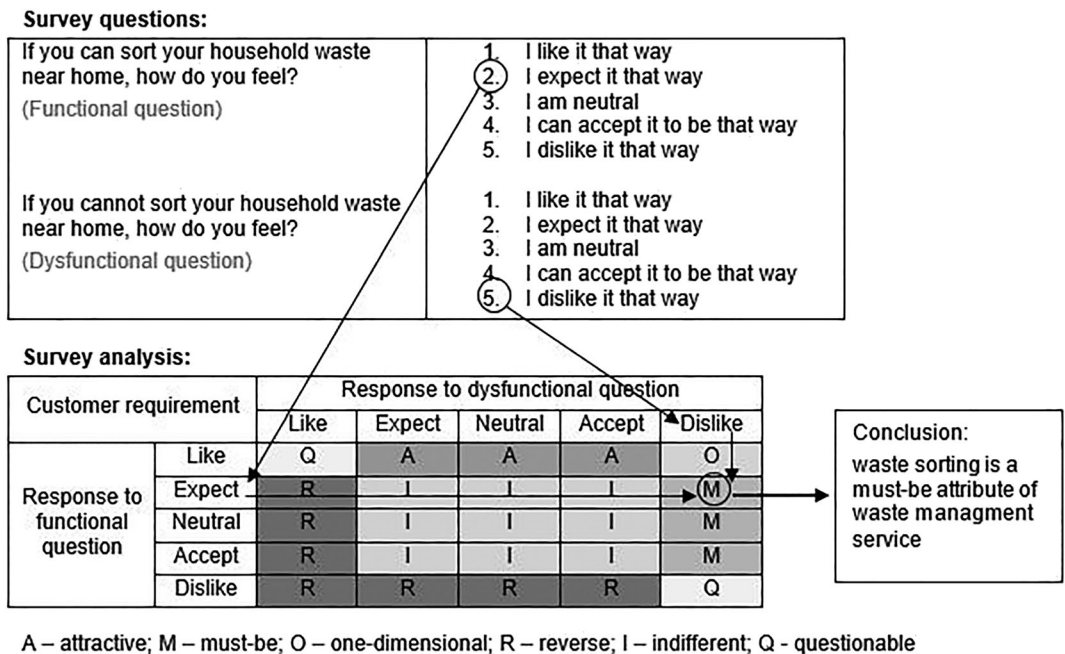


FIGURE 3 The Kano methodology with an example of waste management services (according to Mikulic & Prebežac, 2011)

spreadsheet tools, is provided by several websites (e.g., see Moorman, 2012; Zacarias, 2015).

When two attributes cannot be provided simultaneously due to technical or economic reasons, the attribute with the highest impact on customers' satisfaction should be offered (Chen & Chuang, 2008). Yet the Kano model not only provides valuable guidance in trade-off situations (Conklin, Powaga, & Lipovetsky, 2004) but also serves as a tool for product design and development as such. The Kano model allows designers to identify the attributes that are expected (must-be) to be included in the product design, the attributes that place the designed product superior to competitors' products (attractive), and the attributes that would be of no value (indifferent) to customers. When met, the categories of perceived quality influence customers' satisfaction in different ways and are explained as follows:

1. The must-be or basic quality—attributes of this category are taken for granted, not explicitly demanded, yet their fulfillment does not lead to customer satisfaction. In fact, customers' satisfaction does not rise above neutral, just lead to a state of “not dissatisfied.” Nevertheless, must-be attributes are a decisive competitive factor. Customers become dissatisfied if the product attributes of this category are missing or their performance is low and will not be interested in the product at all (Bilgili, Erci, & Ünal, 2011; Chen & Chuang, 2008; Sauerwein, Bailom, Matzler, & Hinterhuber, 1996).
2. One-dimensional or performance quality—customer satisfaction is a linear function of the fulfillment of the product attribute, that is, the higher is the performance of the attribute, the more satisfied a customer becomes and vice versa. Usually, the one-dimensional

attributes are explicitly demanded by the customer (Bilgili et al., 2011; Chen & Chuang, 2008; Paraschivescu & Cotirle, 2012).

3. The attractive or excitement quality—the attributes of this category have the highest impact on customer satisfaction, as it increases superlinearly with increasing attribute performance. Yet customers' satisfaction does not decrease correspondingly with the decrease of the attribute's fulfillment—there is no feeling of dissatisfaction. The attractive attributes are not explicitly expressed nor expected by the customer (Bilgili et al., 2011; Chen & Chuang, 2008).
4. The indifferent quality—the attributes towards which customers feel indifferent. Fulfillment or absence of these attributes has no effect on customers' satisfaction or dissatisfaction (Chen & Chuang, 2008; Paraschivescu & Cotirle, 2012).
5. The reversal quality—this attribute brings more satisfaction, if absent, and vice versa (Chen & Chuang, 2008; Paraschivescu & Cotirle, 2012).
6. The questionable quality is the one that cannot be mapped because any level of its performance can lead to the customers' satisfaction or dissatisfaction (Min et al., 2018).

The original Kano model was used for more than 20 years until its first refinement was published (Gregory & Parsa, 2013). Löfgren and Witell (2008), Mikulic and Prebežac (2011), Shahin, Pourhamidi, Antony, and Park (2013), and Song (2018) can be consulted for systematic and critical reviews of development and modifications of the Kano model.

3 | ADVANTAGES AND DISADVANTAGES OF THE KANO MODEL

Application of the Kano model in categorizing the quality by perceived customers has several advantages. First, priorities for product or service development can be defined. For example, improving one-dimensional or attractive attributes might influence the customer's satisfaction more than investing in must-be attributes that already are at a satisfactory level (Sauerwein et al., 1996). Second, the product requirements can be understood better—attributes having the greatest influence on customers' satisfaction can be identified. After classifying the product requirements into categories of perceived quality, the focus for product development can be formed (Bilgili et al., 2011). In addition, no technical limitations regarding the number of attributes to be analyzed exist (Mikulic & Prebežac, 2011). Also, the Kano model provides useful assistance in trade-off situations, when two attributes cannot be provided simultaneously due to technical or economic reasons (Conklin et al., 2004). The Kano model creates possibilities for placing one product among other products in the market. A product that meets only the must-be and one-dimensional quality requirements is perceived as an average and hence interchangeable with other products in the market (Bilgili et al., 2011). Finally, the Kano model demonstrates high flexibility of integrating it with other tools,

models, and approaches, quality function deployment being the most utilized (Ek & Çıkış, 2015; Ginting, Hidayati, & Siregar, 2018).

In product development, identifying customer needs, their priorities, and hierarchy is a prerequisite (Griffin & Hauser, 1993). Yet the Kano model has also been criticized for the model's inability to categorize product attributes without quantifying the attributes' numerical or qualitative performance (Gregory & Parsa, 2013). The review by Bi (2012) on the methods for analyzing consumers' satisfaction points out that the Kano model does not give the relative importance of the attributes falling in the same category. Therefore, other techniques, such as tree-based or recursive partitioning models that are generally referred to as data mining, statistical, and machine learning, are advised. Particularly for the research on consumers' satisfaction Bi (2012) suggests the use of Random Forest, variable transformation, and Lindeman, Merenda and Gold's (LMG measure) methods. The Kano model is also criticized for the weighting methods used; thus, the work by Lee, Sheu, and Tsou (2008) proposed the combination of the Kano and fuzzy models to remove any discretions from surveys. Meanwhile, Song (2018) emphasizes the wording of the Kano model and criticizes this model for being ambiguous, cumbersome, and indefinite. The author proposes a new way to ask questions and a 5-point ordinal scale as alternative answers, thus avoiding unidirectional effects on customers' satisfaction. Also, Bharadway and Menon (1997) point out that the Kano model provides no explanation for the factors driving customers' perception towards the importance of the specific attributes, nor explains what the customers' behavioral intentions are. Kuo, Chen, and Deng (2012) criticized the Kano model for underestimating the one-dimensional attributes by overestimating the customers' requirements and individual satisfaction. Shyu, Chang, and Ko (2013) criticized the Kano model for having too much emphasis on products' quality with no consideration of the customers' experience when measuring the perceived quality. Matzler, Fuchs, and Schubert (2004) point to the practical shortcoming of the questionnaire's structure, specifically the need to present each attribute in a functional and dysfunctional manner, thus having a lengthy and onerous questionnaire.

These studies indicate that not only identification of the attributes is important but also the context in which these attributes are used. Also, the characteristics of the consumers are essential to translate these identified attributes into sustainable products that satisfy customers.

4 | SEARCH PROTOCOL

In the following sections, we explore the cases where the Kano model has been used for the assessment of environmental quality.

The aim of the literature review was to systematically analyze the current use of the Kano model for various environmental quality aspects, such as indoor climate, transport, waste management, and water use. In this study, quantitative content analysis was used to assess scientific articles and then to combine them under similar themes (Riffe, Stephen, & Frederick, 2014).

The literature search was done in the Elsevier Scopus database because it is the largest abstract and citation database of peer-reviewed

scientific journals, conference proceedings, and books (Elsevier, 2018). Predefined key words were used for search in the fields of title, abstract, and key words of the scientific articles. These search key words included “Kano model” paired with “city,” “climate,” “indoor,” “emissions,” “environment,” “environmental,” “environmental and quality,” “environmental services,” “environmental products,” “environmental quality,” “life cycle assessment,” “pollution,” “recreation areas,” “transport,” “urban,” “waste,” and “water.” The reference list of the obtained documents also was looked up to further documents.

The search protocol was executed on August 20, 2018, and in total, 119 documents were found that meet the defined search key words. Next, these articles were reviewed based on the content of titles and abstracts, by excluding 74 and 15 studies accordingly. There was a relatively large number of articles excluded by title because the Kano model has been used also in various studies targeting information technologies and linked services, as well as healthcare services and teaching practices, and Kano is also a state located in Nigeria. Later exclusion by title mostly was dealing with sorting out Kano application to industrial technologies, products, and services not linked with the scope of this study (environmental services). Finally, 27 documents were selected for inclusion in this paper (see Figure 4).

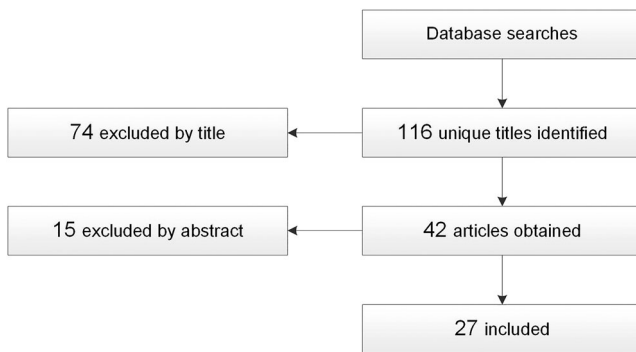


FIGURE 4 The identification process of articles included in this paper

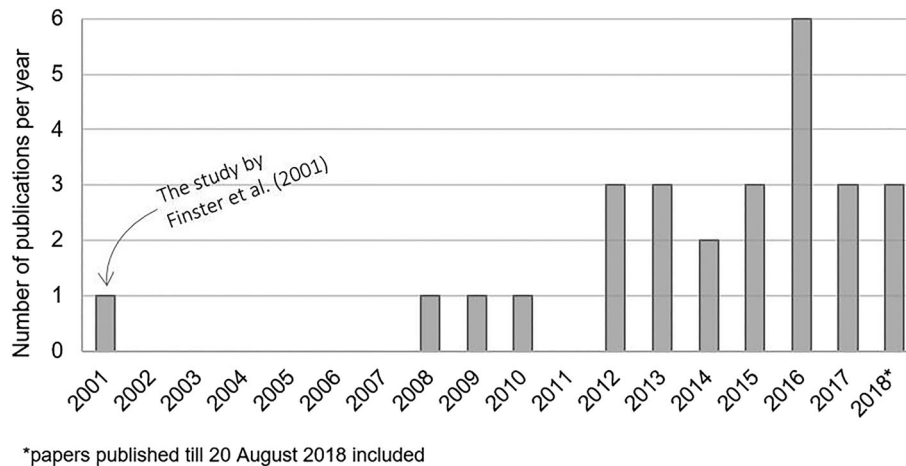


FIGURE 5 Number of publications per year published on the application of the Kano model for environmental quality assessment since the study by Finster et al. (2001)

5 | THE KANO MODEL IN ASSESSING ENVIRONMENTAL QUALITY: EVIDENCE OF APPLICATION

At the beginning of these millennia, Finster et al. (2001) published a study where authors state that the Kano model expands “the toolbox of the industrial ecologist and enables the link between green design and business improvement,” as it makes visible the customers’ perceptions of the critical environmental attributes. In the study, Finster et al. (2001) introduce several environment-related concepts (including environmental product attribute), treat the environment as a customer segment, and demonstrate how efficient the Kano model is in revealing design opportunities and attributes of product or service that consider environmental issues. Finally, authors expand the Kano model to link the environmental attributes to business incentives and strategy, as the business value of the attributes becomes visible. Nevertheless, since Finster et al. (2001) published the study, only a limited number of other works have been published where the Kano model is applied for the assessment of environmental quality (see Figure 5). Thus, one of the main motivations of this study was to present all possible applications of the Kano model for environmental quality management.

Two distinct areas of the application can be identified: urban environmental quality and indoor environmental quality. We find the reason for that may lay in the definition of environmental quality. Johnson et al. (1997) define environmental quality as a measure between the actual environmental condition and optimal conditions for a specific species in a special habitat. With respect to this definition, the application of the Kano model in assessing environmental quality mostly focuses on consumers (residents) and their environments. Thus, we presented various case studies from these domains so that these all divergent applications can be found in one review article and the reader can see the vast application possibilities of this tool.

The contribution of the Kano model to the studies on the quality of the urban environment is onwards discussed. Yin, Cao, Huang, and Cao (2016) used the Kano model integrated with the importance–

performance analysis to study which characteristics of different neighborhoods are viewed by residents as key performance, excitement, basic, and unimportant performance factors, thus identifying the development priorities for the neighborhood's self-improvement. The obtained results allow the local governments to deploy scarce resources for the improvement of satisfaction of the existing residents and the attraction of new residents. Similarly, the Kano model was used to study how satisfied residents are with water supply services and which attributes should be improved to enhance the satisfaction level (Andriani, Anthara, Rebecca, & Setiadi, 2017). Priyono (2016), Högström, Davoudi, Löfgren, and Johnson (2016), and Wu, Cao, and Huting (2018) used the Kano-based methods to study public transport services and found that the critical attributes are a comfort, safety, reliability, and reasonable total travel time. These attributes must be met to increase the popularity of public transportation. Yang, Yan, and Ma (2015) identified the preconditions for acquiring an electric vehicle, where the availability of charging stations is the must-be attribute among others. Meanwhile, Chen, Ko, and Lee (2018), Högström, Rosner, and Gustafsson (2010), Lin, Fu, and Li (2018), Zhang and Wang (2014), and Chen and Ko (2016) applied the Kano model to identify the indicators for the quality of environmental services in recreation areas such as a river bank, a snow park, a suburban mountain, an urban park, and a pedestrian street, respectively. Authors showed the aspects that should be considered in shaping an urban area and its attractiveness to locals and tourists. The study by Jennings and Cain (2013) adapts the Kano model for the evaluation of sound and noise in public urban places based on three groups: urban planners, serious listeners (those who deliberately record or contribute to soundscape), and users of this urban space. This study presents the range of approaches to create positive soundscapes. The Kano model was used by Ceballos and Larios (2016) for the development of an investment model that allows the allocation of resources to areas of highest priority for the residents of a smart city. Thus, promoting smart governance, preventing residents' dissatisfaction, encouraging greater identity and loyalty of the residents with their city, increasing quality of life, and reducing leakage of human talent would be achieved. Finally, the study by Llinares, Page, and Llinares (2013) uses the Kano model to advance the methodology for urban planning. Authors emphasize that investments are often made in the attributes where the residents do not perceive improvements due to the nonlinear relationship between various attributes in the city and residents' perception of these attributes. Llinares et al.'s (2013) research shows that the Kano model provides an effective way for categorizing users' requirements and helps to understand the nature of these requirements considering nonlinearity of users' behavior. Thus, urban planning is achieved in a more resource-efficient and effective way. The above-reviewed studies all demonstrate the application of the Kano model for promoting the satisfaction of urban residents with environmental quality by identifying and prioritizing various aspects and attributes of products and services in an urban setting.

Another group of the studies using the Kano model is for the assessment and management of the quality in an indoor environment.

The application in this field of research is much wider; this article will only give the references to some of the most relevant research in this field by guiding the reader to further explore these resources. The study by Kim and de Dear (2012a) used the Kano model to compare the perceived performance of 15 specific factors of indoor environment quality (e.g., temperature, air quality, and noise level) on occupants' overall satisfaction and productivity and specifically occupants' satisfaction in buildings that have different ventilation systems (Kim & De Dear, 2012b). The review by Shafaghat et al. (2016) for indoor environment quality focuses on the methods and models to determine users' satisfaction in buildings. Authors of the review conclude that the Kano model is the most suitable perception-based tool to model satisfaction of a building's occupants. Jylhä and Junnila (2012) applied the Kano model to identify customer value in the design phase of a nursing home. Environmental issues such as the ability to keep track of water, electricity, and heat consumption were identified as must-be attributes by the future staff of the nursing home. As a result, the application of the Kano model at the design phase of new houses might enhance social sustainability aspects of these buildings. The sustainability and improved perception of buildings are enhanced as well by planned focusing on facility services and management. Maattanen, Jylhä, and Junnila (2014) studied the perception of office tenants about the management of the facility in a "green" and sustainable manner. Authors found that the satisfaction with management of the facility and services would increase by increasing environmental efficiency of the facility, especially regarding those environmental attributes that offer business potential through specialization. Although such self-reported questionnaires may be biased, coupling the self-reported data with actual, measured parameters is widely used in behavioral research. For example, D'Oca, Chen, Hong, and Belafi (2017) used survey responses on the self-reported indoor environment quality in buildings (such as indoor air quality, illuminance level, and temperature) and correlated these self-reported parameters with measured data on solar irradiation, outdoor temperature, and relative humidity. Authors found the causal links between the weather conditions outside and the comfort level of building's occupants inside. Also, in the study by Geng, Yu, Lin, Wang, and Huang (2017) on passengers' satisfaction at an airport, the authors found that the reported satisfaction levels correlated well with the measured indicators of indoor environmental quality, such as CO₂ concentration, illuminance, and noise level. A similar conclusion was found by Martellotta, Simone, Della Crociata, and D'Alba (2016) where both surveys and measurements of indoor environment quality in supermarkets were investigated for 2 years. Here, again self-reported data correlated with measurements, yet the authors of this particular study used not only correlation analysis but also the factor analysis and nonlinear methods based on the Kano model. The study found that all workers in supermarkets can be divided into two groups: (a) workers that were more concerned with visual and acoustic comfort at work and (b) workers concerned with thermal comfort. By separating these two data sets, more precise models for the management of indoor environment can be obtained. A similar study has been carried out in hospitals by Vieira et al. (2016) by pairing the Kano and multinomial

models. Luor, Lu, Yu, and Lu (2015) studied the quality of the indoor environment in a much broader sense by developing the Kano model for the satisfaction of users living in smart houses. Authors found that entertainment, security, and automation correlated with perceived usefulness. These studies on indoor environmental quality indicate that the Kano model is an objective tool suitable for identifying various attributes of environmental quality, especially when coupled with other, instrumental, tools. We further identify and review studies where the application of the Kano model has been extended to integrating it with the tools used in the environmental quality assessment.

6 | INTEGRATION OF THE KANO MODEL WITH ENVIRONMENTAL ASSESSMENT TOOLS

The assessment of environmental quality encompasses tools and methods to converge towards optimal environmental conditions. Moreover, decision makers can employ a wide variety of tools and methods to capture and incorporate knowledge about the environment into their products and services, including check sheets, waste ratio, mass flow analysis, concept hazard analysis, quantitative risk assessment, and various approaches to life cycle assessment (LCA).

Currently, there is a relatively small number of studies where the Kano model has been applied together with other tools for the assessment of environmental quality. Some hardware tools were discussed in Section 5, where the correlation between customer satisfaction and measurement data was identified. Yet there are also a few studies where the Kano model has been integrated with software tools. For example, the study by Kim, Kara, and Hauschild (2017) investigates the advancement of LCA. In the study, the Kano model is used to convert the definition of the static functional unit within the current LCA to the dynamic functional unit that considers changes in consumers' behavior and market structure. This is done by categorizing functions into basic, performance, and excitement, as proposed by the Kano model. The authors argue that only the products with comparable functions should be assessed in the same LCA. This means that when a new product offers various functions of numerous "old" products together, the LCA results of this new product should be compared with LCA results of the numerous "old" products. At the same time, if the "old" generation of the product does not contain the same functions as the new product, the comparison would not be fair. For example, to compare flat-screen TV's LCA with the older generation of cathode-ray tube TV's would not be correct from the perspective of the Kano model, because screen thickness is a basic attribute. And the basic attribute from the Kano theory is of high relevance for a consumer.

Williams, Wikström, and Löfgren (2008) explored food packaging with an integrated Kano model and environmental impacts' assessment in a life cycle perspective. The aim of the study was to investigate how food packaging can be made more sustainable by simultaneously increasing consumers' satisfaction with this environmentally friendly option. For the early design stage of products, Sakao (2009) proposed combining the Kano model with the method of

Consequence and Reason for Requirement. Using this approach, the consumers' willingness to pay for various attributes of the new product can be analyzed, hence assessing which environmental attributes would be more attractive to and demanded by the consumers. Meanwhile, the fuzzy Kano model has been coupled with sustainability assessment by Vinodh, Jayakrishna, and Girubha (2013) to assess the sustainability of an automotive organization. The authors conclude that the application of the Kano model can be extended, thus assisting in the identification of sustainability criteria. Kametani, Nishina, and Suzuki (2010) have applied an integrated approach of the Kano model and Nishio's typification of ecological awareness to evaluate the environmental quality of products depending on the environmental lifestyle of consumers, that is, how quality attributes are perceived by consumers depending on the level of their knowledge about environmental aspects. As an outcome, Kametani et al. (2010) established the relationship between the dynamics of environmental quality of products perceived by consumers (referred to as "the maturity of quality") and the environmental lifestyle.

Also, a combined Kano's model, refined Kano's model, importance-performance model, and improvement index method have been applied by Chiang and Torng (2015) to compare and analyze the key attributes of environmental audit in an aerospace company. They conclude that the method applied provides an effective instrument for promoting sustainability practice of environmental auditing in an organization, that is, auditors' concentration on performance improvement rather than procedures conformance. Bautista-Lazo and Short (2013) have developed a model based on environmental management accounting, the Kano model, and profitability analysis for understanding the impact and potential uses of waste in manufacturing organizations. The developed model suggests that there are 12 types of outputs (waste) that can be effectively managed from an economic and environmental perspective by designing appropriate business strategies. The reviewed studies indicate that the Kano model is highly flexible for the integration with various tools, techniques, and models. Although the number of studies is limited, integration of the Kano model with other methods used in the assessment of environmental quality is encouraged, as it allows capturing the customers' (residents') perception of environmental quality that is a significant aspect in reaching efficient and sustainable use of resources.

7 | THE RELATIONSHIP BETWEEN THE ATTRIBUTES OF ENVIRONMENTAL QUALITY AND SOCIAL BEHAVIOR

Human behavior and environmental quality have been studied interconnectedly using various approaches rooted in the field of environmental psychology. Some of them are the norm activation model (Schwartz, 1977), the theory of reasoned action (Ajzen & Fishbein, 1980), social cognitive theory (Bandura, 1986), and planned behavior (Ajzen, 1991), value-belief model (Stern, Dietz, Abel, Guagnano, & Kalof, 1999), attitude-behavior-context model (Stern, 2000), and goal-framing theory (Lindenberg & Steg, 2007). The research in human

interaction with the environment is studied in a couple of major perspectives. For instance, research is done to foster the behavioral change of consumers to save energy and/or natural resources. For example, Perlaviciute and Steg (2015) studied the choice of energy alternatives based on the value system of consumers; Vīgants, Blumberga, Timma, Ijabs, and Blumberga (2016) researched the diffusion of environmentally sound innovations in households; and Stibe and Larson (2016) studied urban designs and technology-supported spaces for behavioral and attitudinal changes in cities. Another domain of the studies is focused on groups of individuals to develop sustainable public policy. For example, Helm, Pollitt, Barnett, Curran, and Craig (2018) used social cognitive theory to study how to design public policy in order to engage people with various value systems into the adoption of proenvironmental behavior.

Social cognitive theory has successfully demonstrated its relevance and applicability for assessing environmental quality and related factors in an array of previous scientific publications. McAlister, Perry, and Parcel (2008) described the fundamental emphasis of the theory on the interaction between individuals and their environments and human capacities for learning and adaptation. They also demonstrated how this theory has been effectively applied for personal and social change to prevent and manage chronic and infectious diseases and provide useful insight into other problems such as violence and disaster preparedness. Parker, Baldwin, Israel, and Salinas (2004) incorporated the theory to ensure that caregivers had appropriate behavioral capability, that is, knowledge and skills, needed to perform the required behavior such as cleaning. Community environmental specialists worked to improve the caregivers' self-efficacy about performing the required actions to reduce indoor environmental triggers for asthma. The authors applied the idea of reciprocal determinism or the continuing interaction among the characteristics of a person, the behavior of that person, and the environment within which the behavior is performed. They looked into the key concepts of social cognitive theory, including environment, outcome expectations, self-efficacy, behavioral capability, and methods for behavior change, including observational learning and reinforcement.

Krieger et al. (2002) implemented a randomized controlled trial of an education intervention to improve asthma-related health status by reducing exposure to allergens and irritants in homes. For their study, the social cognitive theory suggested the value of an individualized, stage-specific approach that sets manageable priorities, of providing clients with feedback on their implementation of action plans, and of demonstrating actions to reduce exposures. López and Cuervo-Arango (2008) reviewed the relationship between psychological constructs and ecological behavior. Their empirical analysis linked personal values, ecological beliefs, consequences of environmental conditions, environmental control, denial of ecological obligation, personal norms, and environment protection behavior. Pelletier, Dion, Tuson, and Green-Demers (1999) applied concepts of social cognitive theory to study individuals' reasons for their lack of motivation towards environmental protective behaviors, including amotivation because of strategy, capacity, effort, and helplessness beliefs. Chen and Hung (2016) in their study identified determinants of acceptance

of green products, including attitude, subjective norm and perceived behavioral control, social impression, environmental consciousness, and environmental ethics and beliefs to understand and predict the adoption of consumer intentions.

In this study, we further employ the social cognitive theory, as it helps explain how personal, behavioral, and environmental factors are intertwined and continuously affect each other. This triadic reciprocal determinism unfolds multiple angles for studying behavioral change, including environmental and personal change. Human behavior alters environmental conditions and, in turn, is changed by the same conditions that it creates (Bandura, 2009). Similarly, both environmental and behavioral factors constantly influence human attitude, that is, perceptions of the involved people, and vice versa. Behavior represents the actions of a person as the actual response to the current situation. An environment is an aspect that surrounds the person belonging to both physical and social environments. A person represents the types of beliefs, attitudes, and skills the person assigns to the current situation.

The social cognitive theory is instantiated by the attitude-behavior-environment (ABE) triangle (see Figure 6), which is very instrumental to better understand and explain phenomena laying on the intersection of human nature and its surrounding environments. Similar to the Kano model, the social cognitive theory has been applied to help design technology aimed at intentionally affecting human attitude and behavior. For example, the ABE triangle was used by Stibe, Röderer, Reisinger, and Nyström (2019) to study the perspective of positive long-term changes in lives and businesses that are being unified under the transforming well-being theory. Previously, the ABE triangle has been applied to help designing technology aimed at intentionally affecting human attitude and behavior. For instance, Stibe (2014, 2015) has demonstrated how the ABE triangle can foster the designing of engaging environments using socially influencing systems, aimed at user involvement and participation. Further, Stibe and Larson (2016) have expanded this perspective by looking at environmental influencers in cities, thus addressing and reviewing possible urban designs and technology-supported spaces for behavioral and attitudinal changes at scale. Overall, the ABE triangle helps to articulate the perspective of positive long-term changes in lives and businesses that are being unified under the theory of transforming well-being (Stibe et al., 2019).

We see that the Kano model (given in gray color in Figure 6) can be integrated with the social cognitive theory (given in black color in Figure 6) because of the context of environmental quality and related human dynamic that mainly manifests itself through attitudes and behaviors of people. When discussing environmental attributes and their effects on people and their satisfaction towards various levels of quality, it is inevitable to have human behavior and attitude as a coherent part in the holistic picture of this discourse. Obviously, the environment around us and its quality are strongly determined by what kind of footprints people leave in it. Certainly, the impact on the environment most commonly starts with something that people initially think of doing (attitude) and then making it happen (behavior). Such interconnectivity is essentially highlighted by the social cognitive

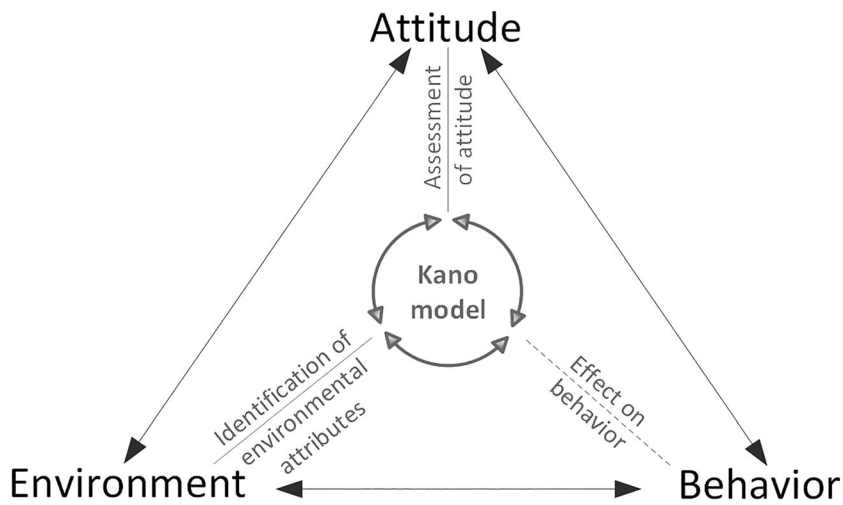


FIGURE 6 The Kano model mapped onto the attitude–behavior–environment triangle

theory. Meanwhile, the ABE triangle explains the dynamic between the attitude, behavior, and environment. Thus, the theory and triangle serve as the next essential layer that helps to position and explaining how the Kano model can be further meaningfully applied to the context of environmental quality and related social behavior. The Kano model is a tool that helps to measure the three elements of the social cognitive theory, whereas social cognitive theory can use these measures to study how the three elements affect each other. Moreover, the triangle helps to integrate the Kano model into a broader perspective that enables seeing it dynamically connected to its surroundings in this applied research context, thus empowering its evolution in a sustainable manner.

The Kano model together with social cognitive theory portrays that well-considered and assessed quality attributes can drive positive individual and social behavior that have a substantial effect on facilitating personal well-being and environmental sustainability. Installation of bicycle paths in a city serves as a trivial example—well-designed infrastructure encourages daily cycling that improves both personal and environmental health. If the technology aimed at promoting the bicycling is added as well, in this case, attitude and behavior can be affected even more. For example, publicly available boards showing instant information on the number of other cyclists may impact an individual to consider cycling, as demonstrated by Hofmeister and Stibe (2017) and Millonig et al. (2016). In addition, social behavior may serve as an indicator of the potential improvements in environmental quality. For example, littering on streets indicates the need for waste collection and management solutions, yet, by assessing the consumer value, the Kano model can identify the specific solutions that will be the most efficient, hence where investments will be used most efficiently.

Moreover, integration of value-based environmental management into an enterprise shows the creation of long-term enterprise value and aid to the resilience of this enterprise to various social and environmental shocks (Figge, 2005). As given by Muñoz-Torres, Fernández-Izquierdo, Rivera-Lirio, and Escrig-Olmedo (2019), currently, agencies that use environmental, social, and governance rating

for enterprises usually identify short-term environmental performance from the perspective of the firm's internal organization and social aspects based on the firm's external judgment, and new tools are needed to account for these all factors in a holistic manner. Finally, Pipatprapa, Huang, and Huang (2017) emphasize that an enterprise manager has to understand the social requirement of concern for environmental protection; hence, tools to assist managers' decision making on environmental evaluation and social aspects are needed.

On the basis of the reviewed articles, we propose to link environmental quality and social behavior into a single model (see Figure 7).

The study by Xu, Wu, and Jing (2017) has demonstrated that from the customers' perspective, perceived quality and customer satisfaction are two different constructs. Thus, in the model, the *actual environmental quality* is formed of a set of attributes that affects how customers perceive this environment (*perceived environmental quality*), whereas the *perceived environmental quality* is evaluated against a set of factors as customers define the *level of satisfaction* under the current conditions, that is, what feelings do customers have for the environment perceived. The main factors affecting the customers' overall satisfaction are *context*, *previous experience*, *expectations*, and *values*.

The customers' *expectations* with respect to the attributes of environmental quality, and how these expectations are met, differ among various groups of customers; hence, also the responses of the customers to various attributes differ. For example, customers living in an area with overall good service quality of environmental cleanliness are critical to the area when the expectations of cleanliness are not met. Conversely, customers used to, for example, litter in their surrounding will accept such “untidy” environment as their evaluation of the service performance will not be negatively affected. Expectations are affected by the *context* in which the attributes of environmental quality are judged. The customers can have dissimilar feelings towards an attribute placed in two different environments. For example, installing greenery in a rural area might be perceived with a lower value than in an urban area. Sometimes, attributes of environmental quality may be perceived even negatively although the initial intention has been positive, for example, the greenery in a rural area might be

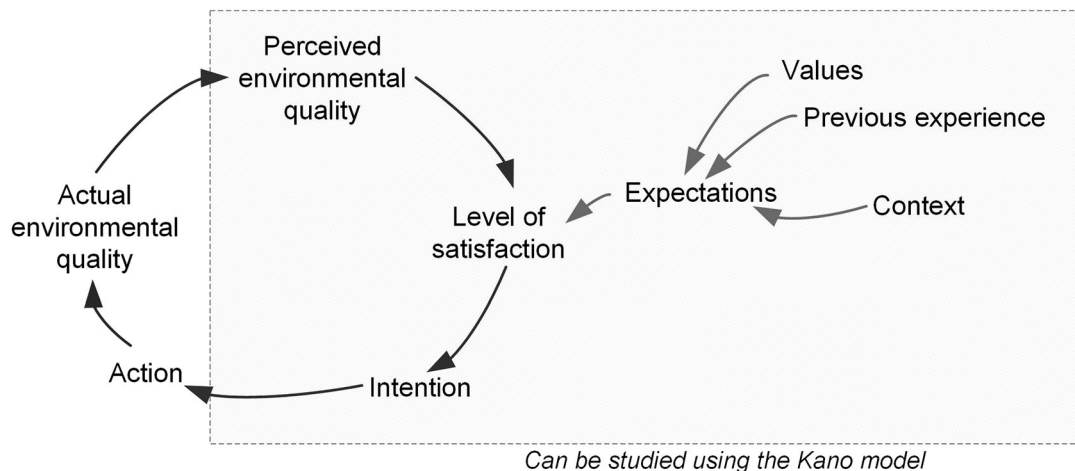


FIGURE 7 The relationship between environmental quality and social behavior

viewed as a waste of money, although the plan was to develop a nicer local landscape. Meanwhile, *previous experience* may define customers' perception of an attribute, especially considering the dynamic change of perceiving an attribute over time (see Section 2). For example, a recreation area nearby may be perceived as an attractive attribute by a customer that has not previously experienced such conditions, whereas the same conditions might be a must-be attribute to a customer that has had the nearby located recreation area before. Finally, the perceived environmental quality attributes are evaluated against an internal set of *values* of an individual or society, as, for example, social norms. Customers are satisfied with an environment, when it supports their requirements (needs and wants), that is, when an environment meets certain quality criteria or preference system of an individual or society. The preference system, in its turn, is affected by a number of factors—cultural, socioeconomic, demographic, geographical, and so forth. Thus, an individual or society has its own components representing the preferred image of satisfying environmental quality.

The *level of satisfaction* with the environment forms an *intention* that has an effect on the *action* performed in and towards the environment. The action performed, in turn, affects the *actual environmental quality*, thus closing the loop, that is, the attributes of an environment (resulting in environmental quality) affect the individual and social behavior in that same environment. Defining the level of satisfaction with environmental quality is the field of research of the Kano model. The relationship shown in Figure 7 is tied to the findings of environmental psychology.

We conclude that integration of the Kano model and social cognitive theory may serve as an instrument for designing an environment that not only is perceived as of high quality but also changes customers' attitude and behavior. This framework can be useful for scientists that study systems' interrelationships, such as natural environment, social behavior, and norms, but at the same time would like to base this holistic model on the data based on consumers' feelings and satisfaction. This framework can be used for studying a wide range of environmental products and services.

8 | DISCUSSION AND CONCLUSIONS

The Kano model has been used extensively within industries and academic research and within a variety of contexts demonstrating its wide applicability. Furthermore, since the end of the 1990s, the number of studies on quality management that use the Kano model has increased and continues to grow. Thus, it can be stated that the influence of the Kano model in quality management and its research is significant, and there is no evidence that the importance of the Kano model would lessen in the years to come. Meanwhile, for the assessment of environmental quality, the Kano model is limited to several case studies of urban and indoor environmental quality. Although the Kano model is well adapted and validated in the studies of urban and indoor environmental quality, the application to other areas of environmental quality is rare to find. We believe there are several potential reasons for this.

The definition of environmental quality and terminology applied in the study area may cause ambiguity with respect to how the Kano model can be applied to solve the problems of environmental quality. It might be difficult to define the specific attributes of environmental quality. Also, the formulation of precise questions and the level of the comprehension by respondents may cause difficulties in the application of the Kano questionnaire. Moreover, the interpretation of the obtained survey results may create difficulties. Many of the reviewed studies indicated that grouping the responses by context, demographics, or other characteristic parameters is important. Perception of consumers differs depending on consumers' previous experience, expectations, and other factors. Hence, the results of satisfaction with an attribute present in the environment, product, or service will make the most sense when grouped by respondents' profile. Thoughtful use of the Kano model is required to obtain results that are representable and help to reach a sustainable goal.

Meanwhile, a wide range of various environmental assessment tools, methods, and even systems exist that are extensively used by academia and industry. The Kano model might not yet find its place among the commonly applied research tools, or the Kano model

simply has not gained sufficient popularity due to aforementioned reasons. In addition, the Kano model is rarely used as a seldom method. In most studies, it is integrated with some other method, quality function deployment, and importance–performance analysis being the most utilized. Still, the Kano model has been useful in studies where understanding the change over time of the customers' perception is important.

Finally, the Kano model rarely helps to gain clear answers to which specific attributes are most significant in achieving the customers' satisfaction. The method does not allow understanding how much the specific attribute contributes to the overall value of the design or plan. Thereof, it has limitations with respect to ranking the worth of environmental quality attributes. Moreover, monetizing environmental quality is a challenging discipline by itself.

Although the Kano model has several limitations, it can provide valuable insights in environmental quality problems, especially when applied in a well-designed and contextual manner. Considering the findings of the studies reviewed, it can be concluded that the Kano model has a high potential and a relevant methodology for application in the assessment of environmental quality. The Kano model is suitable both for screening type of research, where the main aim is to identify the major factors, for example, influencing comfort levels of residents, and for optimization type of research, where survey results are paired with measurements to determine optimal environmental conditions. In addition, the potential range of the application in assessing environmental quality attributes is wide despite that the current application and range evidenced in studies are limited to urban and indoor environmental quality. Finally, the Kano model is also instrumental for researchers and practitioners in designing and deploying innovations aimed at sustainable social behavior and transforming well-being. In this paper, we have identified the potential integration of the Kano model and social cognitive theory (Bandura's triangle) for driving change of the customers' attitude and behavior via changing the perception of environmental quality. In the future studies, practical implementation and validation of the integrated model are suggested to test its applicability and efficiency.

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