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A Statistical Comparison Study of a Real-Life Survey Data on Procedural Justice via Neutrosophic Likert Scale with Score Function and Classical Likert Scale

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Abstract:

The present study aims to examine the distinctions between Likert and Neutrosophic scales in their ability to measure organizational behaviors and the many dimensions of organizational justice. To evaluate procedural justice, 6 questions measuring procedural justice from the Learning Environment Questionnaire were used. Compared to the Likert scale, the Neutrosophic scale exhibited greater decision weights and a more distinct expression of participants' ideas due to its ability to capture more complex replies. The reliability of both scales was found to be high, as indicated by satisfactory Cronbach's alpha coefficients. The results of the exploratory factor analysis indicated that both scales consisted of two sub-dimensions. However, it was observed that the Neutrosophic scale did not necessitate reverse coding for specific items, unlike the Likert scale.This suggests a potential advantage in terms of clarity and interpretability. Furthermore, the study revealed that age and faculty type exerted a substantial impact on participants' replies. Notably, there were considerable variations seen among different age groups on the Likert scale, as well as across different faculty types on the Neutrosophic scale. The results indicate that the Neutrosophic scale may yield more consistent and dependable data, particularly in varied demographic settings.

Keywords: Organizational justice, Likert scale, Neutrosophic Likert Scale, Neutrosophic sets, Neutrosophic survey, Neutrosophic logic, Exploratory factor analysis, Paired samples t test, Procedural justice, score function

1. Introduction

1.1. Organizational Justice and its Sub-Dimensions

Greenberg first used the term "organizational justice" in the 1980s [1]. The concept of organizational justice pertains to the processes by which workers assess the fairness of their treatment at work and the implications of these assessments on other variables associated with the workplace [2]. Organizational justice is defined by Colquitt and colleagues [3] as a person's belief that decisions and processes within the organization are fair and how this affects behavior. The degree to which members of an organization believe that the rules, regulations, and policies pertaining to their jobs are generally fair is known as organizational justice [4]. "Equity in the rules and social norms that govern companies" is what organizational justice is defined as [5]. According

to justice as seen through the prism of social exchange theory, members of an organization are more likely to feel satisfied and loyal when they believe they are being treated fairly, which increases the likelihood that they will make a commitment to the organization. They will display extra-role behaviors as a result of this circumstance [6, 7]. Robbin and Judge [8] state that distributive, procedural, and interactional justice are all included in the broad definition of organizational justice.

In social change interactions, when one party feels being treated fairly, the other party is more likely to go beyond duty. According to Gibson, [10] organizational justice is the degree to which an individual feels treated equally within the organization in which he or she works. Organizational justice refers to a person's perspective on decisions taken by their superiors. There are 3 (three) types of organizational justice: distribution justice, procedural justice, and interaction justice (10). Organizational justice is viewed by most researchers as the three dimensions of distribution justice, procedural justice, and interaction justice [11,12,13]. 1) Distributive justice: this is largely based on equity theory [14]. Distributive justice consists of perceptions of the consequences of distributive decisions [15]. 2) Procedural justice: The procedure was introduced by Thibaut and Walker [16], who examined the fairness of processes in legal transactions. It refers to the perception of fairness towards the procedures used to determine decisions about outcomes [17]. (3) Interactional justice: introduced by Bies and Moag, refers to how people are treated in the process of practices [18].

Important steps towards procedural justice have been made by Thibaut and Walker [16]. Distribution equity is expressed by people's reactions to payment decisions, while it is also expressed in how people react to the way these decisions are made [19]. While Thibaut and Walker were interested in decisions relating to the settlement of legal disputes, Levanthal [20] focused on more general award decisions in his theory. A set of procedural elements are used to assess whether procedures are fair, such as the selection of decision-making representatives, the establishment of basic rules for the assessment of potential awards, methods of gathering information, procedures defining the decision process, appeal procedures, necessary safeguards for non-abuse of authority, and the existence of exchange mechanisms. The fairness of the procedures for the distribution of prizes, he argued, relates to factors such as the consistency of allocations to be created, the prevention of bias, the accuracy of information, the correction ability, the responsiveness to the concerns of all recipients, and the degree to which moral and ethical standards are upheld.

Numerous scholars with a vested interest in organizational processes have endeavored to implement the theory within organizational contexts through the undertaking of comprehensive investigations on procedural justice [21,22]. The study conducted by Magnavita et al. (23) has demonstrated a correlation between diminished perceptions of procedural justice and the occurrence of mental and physical health issues. Procedural justice pertains to the equitable nature of the procedural framework that culminates in specific outcomes [24]. This dimension pertains to the procedural measures undertaken by management in order to arrive at a decision that is just and impartial. This pertains to matters concerning the measures implemented to achieve equal employment and promotion opportunities, establish a just system of rewards, and implement equitable disciplinary actions. Procedural justice, when effectively upheld, guarantees equitable access to promotion opportunities for all employees, devoid of any form of bias or prejudice [25].

Procedural justice additionally guarantees the establishment of equitable and widelyrecognized reward systems for all individuals. Therefore, it guarantees equity in organizational policies concerning the allocation of rewards or penalties to individuals, thereby establishing a levelplaying field for all individuals to pursue specific rewards for accomplishing predetermined objectives or tasks [26]. The fairness of procedures is associated with various factors, including the inclusion of employees in decision-making processes, the provision of information regarding the outcomes, and the elucidation of the rationale behind the decisions made [27]. Procedural justice also pertains to the measures undertaken by the same governing body in order to arrive at an equitable resolution. Procedural justice has been assessed by researchers using two primary methods: process control and decision control [28]. The concept of process control pertains to the degree of influence that employees possess over the decision-making process, as well as the circumstances in which these decisions are made. In contrast, decision control examines the degree

to which employees possess the ability to exert influence over the underlying rationales that drive decision-making within an organization [29].

Numerous studies have indicated a correlation between organizational justice and various outcomes, including job performance [30], job satisfaction [31], organizational citizenship behavior [32], psychological distress [33], intention to leave [34,35], and job involvement [36]. According to the literature, there exists a potential variation in the association between job satisfaction and organizational citizenship behavior with respect to organizational justice factors, specifically distributive, procedural, and interactional justice [37]. A study conducted among employees of a Japanese manufacturing company reveals a significant correlation between job performance and procedural justice, while no such correlation was found with interactional justice [30]. Another study has demonstrated a significant correlation between distributive justice and unit-level performance, specifically in terms of productivity and customer satisfaction. Additionally, interactional justice has been found to have a strong association with organizational citizenship-level processes [38].

Based on the findings, it is deemed suitable to analyze the three components of organizational justice in isolation from one another [39].

1.2. Likert Scale

The popular psychometric Likert scale, used in the social sciences to measure respondents' attitudes with survey questions, was first proposed by the American social psychologist Likert in 1932. This scale asks participants to indicate their levels of agreement with the questions. For example, for a 5-point Likert scale, agreement levels are evaluated by the integer values 1 (strongly disagree) to 5 (strongly agree), and the results are obtained by taking the sum or average of each participant's scores [40].

Likert scales are widely used because they are easy to administer, score, and understand. Additionally, researchers can collect large amounts of effective and inexpensive data in less time and conduct analyses using easy mathematical calculations. Moreover, it is a suitable method for making statistical inferences with good reliability and producing appropriate results.

Although the Likert scale is useful, it also has several disadvantages, such as un-certainty regarding whether responses and measured data should be on an ordinal or interval level. It is assumed that the Likert method has the characteristics of an interval scale [40]. However, many argue that the Likert scale is ordinal [41,42]. An interval scale dictates that there must be an equal interval between any two consecutive scales. For example, for a 5-point Likert scale, each level of agreement is expressed as follows: 1 = "strongly disagree"; 2 = "disagree"; 3 = "neutral"; 4 = "agree";and 5 = "strongly agree". Here, although the emotional intensity between "strongly disagree" and "dis-agree" is considered to be equivalent to the emotional intensity between other consecutive categories, participants may not understand the distances between two points of the scale as equal [43]. In this case, this scale will fail to measure actual responses.

When responding to a question on a Likert-type scale, participants must trans-form their feelings and thoughts into a linguistic expression that is coded with natural numbers and characterized by a ranking order, which can result in information loss, uncertainty, and inaccuracy [44]. Furthermore, the fact that participants' replies may be influenced by earlier questions and theirtendency to avoid selecting extreme possibilities on the scale both pose issues.

Because of the difficulties and uncertainties mentioned above, it was thought that the Likert scale may not be the best scale to measure the level of importance among various attributes. Therefore, this has led many researchers to propose different types of scales. In one study, to obtain superior measurements, a Neutrosophic approach based on fuzzy sets theory was used as an alternative to the Likert scale. Between November and December 2022, a survey was conducted among 1160 young clinical nurses from five hospitals in China's Henan province to investigate the effect of organizational justice on young nurses' turnover intention. The organizational justice scale,turnover intention scale, organizational climate scale, and emotional labor scale were used. The organizational justice scale was scored on a 5-point Likert scale (1 = "strongly disagree"; 2 =

"disagree"; 3 = "undecided"; 4 = "agree"; and 5 = "strongly agree"). It was concluded that organizational justice had a significant effect on turnover intentions among the young nursesthrough the chain mediation of organizational climate and emotional labor [45].

In addition, a survey was conducted with 400 employees to investigate the relationship and impact of organizational justice on employee creativity through the mediating role of leadership styles for academics and staff at Dhofar University in Oman. All items were rated on a 5-point Likert scale. Organizational justice was discussed along the following four dimensions: distributive, procedural, interpersonal, and in-formational. The results revealed that organizational justice had a positive and significant impact on the distributive, interpersonal, and informational dimensions of employee creativity, whereas procedural justice had a negative and significant impact on employee creativity [46]. Aiming to examine the relationship between organizational justice (procedural, distributive, informational, and interpersonal justice) and organizational citizenship behavior, a survey was administered to 121 faculty members working in ten private universities in Bangladesh. The participants were required to respond to all items using a 5-point Likert scale, ranging from 1 ("strongly disagree") to 5 ("strongly agree"). The study also provided the necessary guidelines on ways organizations can increase citizenship behavior, with an emphasis on fairness and inclusion in the workplace [47].

To develop a strategy to improve the working conditions of nurses in Japan, a survey was administered to nurses using a 5-point Likert scale (1 = "strongly disagree"; 2 = "disagree"; 3 = "undecided"; 4 = "agree"; and 5 = "strongly agree") using three scales: ease of work and organizational justice; organizational citizenship behavior; and job satisfaction. A significant positive correlation between interactional justice and job satisfaction has been reported fairly consistently [48]. To determine the effects of organizational support and organizational justice, a survey was applied to trainees in Basque cuisine during the 2022–2023 academic year. In the study, a7-point Likert-type scale was used. It was concluded that organizational support and organizationaljus-tice structures positively affected the happiness parameter at work [49].

In another study, a survey was administered to employees in various sectors in China, including manufacturing, construction, finance, information technology ser-vices, and wholesale and retail sectors, to examine the effects of information justice on employees' retention of information through organizational identification and to investigate how justice sensitivity moderates these effects. In this context, informational justice, justice sensitivity, organizational identity, and information hiding scales were used. All items forming the scale were evaluated usinga 5-point Likert scale [50]. To show the importance of organizational justice and citizenship behaviorin employees' compliance behaviors toward ISPs (information security policies), a survey was con-ducted on IS users in public and private banks in Ethiopia. A 5-point Likert scale, ranging from 1("strongly disagree") to 5 ("strongly agree") was used for all measurements in the study. Additionally, an empirical determination was made regarding the mediating role of organizational citizenship behavior between the dimensions of organizational justice and willingness to comply with ISPs [51].

To understand the antecedents of organizational justice, the authors conducted a national survey of library employees and compared the predictive power of perceived organizational support, job autonomy, job feedback, and job stress. Organizational jus-tice consisted of four subdimensions: distributive justice (4 items), procedural justice (7 items), interpersonal justice (4 items), and informational justice (5 items). Responses were received from the participants to each statement on a 5-point Likert scale (1 = "strongly disagree"; 2 = "disagree"; 3 = "undecided"; 4 = "agree"; and 5 = "strongly agree"). As a result, they found that providing meaningful and timely work feedback, as well as strengthening perceptions of institutional support and autonomy, can be effective in increasing librarians' overall perceptions of fairness [52]. A survey was conducted to determine the impact on the innovative work behavior of employees operating in the Chinese telecommunications industry. Distributive, procedural, and interactional justice items, representing three subdimensions of organizational justice, were included used with a 5-point Likert scale (1 = "strongly disagree"; 2 = "disagree"; 3 = "undecided"; 4 = "agree"; 5 = "strongly agree"). The study

concluded that organizational justice has a significant and positive effect on employees' innovative work behaviors and knowledge sharing [53].

The "Fair Learning Environment Scale", which was developed by Özer and Demirtaş (2010) [54] and Lizzio, Wilson, and Hadaway (2007) [55], was used in a Turkish validity and reliability study. The Kaiser–Meyer–Olkin (KMO) value of the scale was determined to be 0.83 by Özer and Demirtaş (2010) [54], and the internal consistency coefficient was determined to be 0.87 for the total scale. A scale with ten questions measuring distributive justice, which consisted of two subdimensions, distributive and procedural, was used.

1.3. Neutrosophy and Neutrosophic Set

Florentin Smarandache developed the philosophical and mathematical framework called Neutrosophy [56] in the late 20th century. This specific area of research focuses on matters and principles that involve uncertainty, vagueness, and inconsistencies. Neutrosophic logic provides an expanding framework to classical, fuzzy, and intuitionistic fuzzy logic, allowing for the representation of uncertain, contradictory, and ambiguous information. Classical logic encompasses propositions that possess binary truth or falsehood, while Neutrosophic logic permits declarations to possess truth, falsehood, and indeterminacy simultaneously. This facilitates a more advanced and flexible methodology for logical reasoning. Neutrosophic set theory is a theoretical framework that builds upon classical, fuzzy, and intuitionistic fuzzy set theory. It aims to tackle the difficulties that arise when dealing with sets that consist of members that are indeterminate or uncertain. The classification of an element in classical set theory is determined by its membership or non-membership in a set. In the context of Neutrosophic set theory, an element has the potential to exhibit varying degrees of membership within a given set, be devoid of any degree of membership, or lack any degree of membership within the set. The concept of neutrosophic probability represents an expansion of the traditional theory of probability, specifically designed to tackle the complexities presented by events that are unpredictable and uncertain. In the realm of classical probability theory, events are distinguished by clearly defined probabilities that span from 0 to 1. A more comprehensive representation of uncertainty can be achieved by examining the correlation between events in Neutrosophic probability and degrees of truth, falsehood, and indeterminacy.

The application of Neutrosophy has been observed in various fields including artificial intelligence [57], decision-making [58,59,60], information fusion [61], and risk analysis [62], where the proficient handling of uncertainty and ambiguity is crucial. The presented paradigm provides a systematic method for dealing with situations where classical logic and probability theory may need to be revised due to conflicting or uncertain data. The classification of an element in classical set theory is determined by its membership or non-membership in a set. The determination of element membership in a set is predicated upon binary terms, in accordance with the binary scenario. Zadeh [63] introduced the notion of fuzzy set theory, which enables a methodical assessment of the membership of elements within a set by employing a membership function that is constrained within the real unit interval [0,1]. In the domain of fuzzy set theory, crisp sets are frequently denoted as classical binary sets. Fault set theory can be comprehended as a continuation of classical set theory. Intuitive fuzzy sets are defined by elements that have varying degrees of membership and non-membership. The intuitionistic fuzzy set was introduced by Atanassov [64] as an extension of the fuzzy set concept, which builds upon the traditional notion of a set. The field of Neutrosophic set theory [56] presents a comprehensive framework that includes intuitionistic fuzzy sets, classical sets, fuzzy sets, dialetheist sets, paradoxist sets, tautological sets, and intuitionistic fuzzy sets. These various types of sets are based on the fundamental principles of Neutrosophy. In the set, a member x(T, I, F) is deemed true when its degree is $T \in [0,1]$, ambiguous when its degree is $I \in [0,1]$, and false when its degree is $F \in [0,1]$.

This section aims to present essential definitions and concepts related to single-valued neutrosophic sets, fuzzy sets, and intuitionistic fuzzy sets

Definition 1. [63] A fuzzy set X in $\boldsymbol{U}$ is a set of ordered pairs, defined as $\boldsymbol{X} = \{(\boldsymbol{x}, \mu_{\boldsymbol{X}}(\boldsymbol{x}))|\boldsymbol{x} \in \boldsymbol{U}\}$, where $\mu_{\boldsymbol{X}} : \boldsymbol{U} \rightarrow [\boldsymbol{0}, \boldsymbol{1}]$ is termed the membership function of X, and $\mu_{\boldsymbol{X}}(\boldsymbol{x})$ is the degree of membership of the element x in X given a universal set U and a generic element, represented by x.

Definition 2. [64] An intuitionistic fuzzy set X exists over a discourse-level world. The representation of U is given by $\boldsymbol{X} = \{(\boldsymbol{x}, \mu_{\boldsymbol{X}}(\boldsymbol{x}), \boldsymbol{\nu}_{\boldsymbol{X}}(\boldsymbol{x}))|\boldsymbol{x} \in \boldsymbol{U}\}$, where the terms "membership function of X" and "non-membership function of X" for x in X are, respectively, $\mu_{\boldsymbol{X}} : \boldsymbol{U} \rightarrow [\boldsymbol{0}, \boldsymbol{1}]$ and $\boldsymbol{\nu}_{\boldsymbol{X}} : \boldsymbol{U} \rightarrow [\boldsymbol{0}, \boldsymbol{1}]$. The formula for determining the degree of non-membership of an element, x, in X is $\mu_{\boldsymbol{X}}(\boldsymbol{x}) + \boldsymbol{\nu}_{\boldsymbol{X}}(\boldsymbol{x}) \leq \boldsymbol{1}$. The hesitation degree of an element x defined by $\boldsymbol{\pi}_{\boldsymbol{X}}(\boldsymbol{x}) = \boldsymbol{1} - (\mu_{\boldsymbol{X}}(\boldsymbol{x}) + \boldsymbol{\nu}_{\boldsymbol{X}}(\boldsymbol{x}))$.

Definition 3. [56, 65] Let U be a discourse universe. $\boldsymbol{N} = \{(\boldsymbol{x}, \boldsymbol{T}(\boldsymbol{x}), \boldsymbol{I}(\boldsymbol{x}), \boldsymbol{F}(\boldsymbol{x})) : \boldsymbol{x} \in \boldsymbol{U}\}$ is a neutrosophic set, denoted by a truth-membership function, $\boldsymbol{T}_{\boldsymbol{N}} : \boldsymbol{U} \rightarrow]^{-}\boldsymbol{0}, \boldsymbol{1}^{+}[$; an indeterminacy-membership function, $\boldsymbol{I}_{\boldsymbol{N}} : \boldsymbol{U} \rightarrow]^{-}\boldsymbol{0}, \boldsymbol{1}^{+}[$; and a falsity-membership function, $\boldsymbol{F}_{\boldsymbol{N}} : \boldsymbol{U} \rightarrow]^{-}\boldsymbol{0}, \boldsymbol{1}^{+}[$.

Definition 4. [56, 65] Let U be a discourse universe. A single-valued neutrosophic set is defined as $\boldsymbol{N} = \{(\boldsymbol{x}, \boldsymbol{T}(\boldsymbol{x}), \boldsymbol{I}(\boldsymbol{x}), \boldsymbol{F}(\boldsymbol{x})) : \boldsymbol{x} \in \boldsymbol{U}\}$, which is identified by a truth-membership function, $\boldsymbol{T}_{\boldsymbol{N}} : \boldsymbol{U} \rightarrow [\boldsymbol{0}, \boldsymbol{1}]$; indeterminacy-membership function, $\boldsymbol{I}_{\boldsymbol{N}} : \boldsymbol{U} \rightarrow [\boldsymbol{0}, \boldsymbol{1}]$; and falsity-membership function, $\boldsymbol{F}_{\boldsymbol{N}} : \boldsymbol{U} \rightarrow [\boldsymbol{0}, \boldsymbol{1}]$, with $\boldsymbol{0} \leq \boldsymbol{T}_{\boldsymbol{N}}(\boldsymbol{x}) + \boldsymbol{I}_{\boldsymbol{N}}(\boldsymbol{x}) + \boldsymbol{F}_{\boldsymbol{N}}(\boldsymbol{x}) \leq \boldsymbol{3}$.

1.4. Neutrosophy in Social Sciences

Smarandache [66] defines Neutrosophic Sociology, also referred to as Neutrosociology, as the utilization of neutrosophic scientific methodologies in the field of sociology. The utilization of questionnaires is widely acknowledged as an essential instrument in surveys [67] for evaluating the prevailing opinions within social collectives. The preference for fuzzy responses over crisp responses in surveys is widely recognized. However, it is crucial to acknowledge that fuzzy processing may not necessarily capture the intended meaning of the responder due to uncertainties, confusion, and unclear thinking. By employing neutrosophic sets in modeling this scenario, responders are presented with a broader spectrum of possible responses, thereby increasing its significance.

This paper presents a methodology for creating neutrosophic sets with a single value by using questionnaires distributed to social groups. In the field of Social Sciences, the study [68] presented a comprehensive elucidation, illustration, and initiation of neutrosophic statistical techniques. The field of Social Sciences often encounters inconsistencies in the data presented, which can be attributed to errors, conflicts in information and knowledge sources, lack of objectivity in certain viewpoints, and other contributing factors. Therefore, it has been argued that in certain circumstances, the incorporation of interval data may be deemed essential.

1.5. Neutrosophic Score Function

The scoring function s: [0,1] → [0,3], represented as s(a) = 2+ T - I - F, was utilized by Martinez et al. [67] to measure neutrosophic characteristics and perform a comparative analysis in the context of social science. However, our main focus is on the analysis of the measurement related to the influence of collective decision-making on societal decisions. It is noteworthy that the utilization of this specific scoring function was not implemented in a study employing a Likert-type scale. The utilization of the score function was first implemented in a Likert essay, and [67] provided evidenceof its reliable utilization in the realm of social sciences. The s(a) = (1 + T - 2I - F)/2 function utilized inthis study is derived from the publication referenced as [69]. It is deemed suitable for an initial workspace to incorporate an evaluation of the adverse, neutral, and beneficial consequences by distributing the score values within the range of [-1, 1]. This approach is consistent with themethodology employed in neutrosophic research.

1.6. Neutrosophic Likert Scale

In this study, the neutrosophic Likert scale was implemented for the first time [70]. Life satisfaction on a traditional scale The Likert scale items were converted to numeric values ranging from 0 to 100. Respondents were anticipated to select one of the following: "I agree with this statement (…)," "I am neutral (or indifferent) regarding this statement (…)," or "I disagree with this statement (…)." The findings presented in the study indicate that the neutrosophic scale exhibits comparable reliability to the classical scale, as Cronbach's Alpha remains within an acceptable rangefor all three dimensions.

In the present investigation, we employ a direct percentage understanding framework to facilitate a closer approximation to natural language. Fuzzy sets and Neutrosophic Likert scales share a commonality in their approach to managing imprecision and uncertainty. Neutrosophic sets, including Neutrosophic Likert scales, offer a broader representation that encompasses indeterminacy as a fundamental element. On the other hand, fuzzy sets facilitate the representation and manipulation of data that lacks precise specification. Neutrosophic Likert scales are particularly suitable for survey responses that involve participants' opinions that are not only varied across a spectrum (as accommodated by fuzzy sets), but also include a degree of indecision or neutrality that is challenging to capture using traditional fuzzy logic or crisp Likert scales.

The questionnaire was prepared using Google forms, an effective data-gathering tool, to evaluate college students' attitudes to procedural justice. The number of participants was determined to be 119 using G*Power 3.1.9.4. 126 university students were surveyed using the Likertscale of 5 degrees (1 = "absolutely disagree", 2 = "not agree", 3 = "no resolve", 4 = "agreed", 5 = "definitely agree") and the neutrosophic scale, respectively, as described in Table 1 and Table 2.

The participants completed the survey by marking only one of these five agreement values. The research data can be accessed from the following link: https://osf.io/xd4t7.

Table 1. Likert Scale Questions (responses should be indicated by marking a single choice with a check mark)

Questions	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
There are effective procedures in place to help students solve problems.	☑	☐	☐	☐	☐
It is not clear what to do when a student has a problem.	☐	☐	☑	☐	☐
There is an effective system for lodging complaints of unfair treatment.	☐	☐	☐	☐	☑
Students can get the advice or help they need.	☐	☑	☐	☐	☐

There is no point in complaining as nothing will really be done.	☑	☐	☐	☐	☐
Educational information is provided to students in an easily accessible way.	☐	☐	☐	☑	☐

The researchers utilized the neutrosophic scale, which consists of three levels (a: agreement, b: indeterminacy, c: disagreement), to assess the procedural justice. The questions that have been chosen are presented in Table 2. The survey participants, who were the same participants surveyed before (as indicated in Table 1), chose percentile values a, b, c, and one. Based on the single-valued neutrosophic set methodology, the cumulative percentiles (%) of variables a, b, and c were found to range from 0 to 300. Subsequently, a single percent of these percentiles was selected and assigned to the closed interval [0, 1].

Table 2. Neutrosophic scale questions (responses are to be completed as percentages)

Questions	Agreement Degree	Indeterminacy Degree (Neither Agree Nor Disagree)	Disagreement Degree
There are effective procedures in place to help students solve problems.	50	30	80
It is not clear what to do when a student has a problem.	0.8	40	10
There is an effective system for lodging complaints of unfair treatment.	0	25	100
Students can get the advice or help they need.	15	25	75
There is no point in complaining as nothing will really be done.	29	0.5	89
Educational information is provided to students in an easily accessible way.	58	60	7.5

The demographic information of the survey participants is shown in Table 3 as count (percentage).

Table 3. Demographic characteristics of participants

Categorical Variables	n (%)
Gender	
Female	82 (65.08)
Male	44 (34.92)
Age	
18–21	45 (35.71)
22–24	47 (37.30)
25–30	24 (19.05)

31–40	5 (3.97)
41⁺	5 (3.97)
Faculty	
Vocational School of Hizan	39 (30.95)
Vocational School of Health Services	19 (15.08)
School of Physical Education and Sports	10 (7.94)
Vocational School of Tatvan	8 (6.35)
Faculty of Science and Letters	18 (14.29)
Faculty of Fine Arts	4 (3.17)
Faculty of Health Sciences	7 (5.55)
Vocational School of Güroymak	5 (3.97)
Faculty of Islamic Sciences	16 (12.70)
Marital status	
Married	9 (92.86)
Single	117 (7.14)

The following tables show the participants' responses to Likert and Neutrosophic scales (Table 4, Table 5, Table 6, Table 7).

Table 4. Responses from participants using a Likert scale

	Q1	Q2	Q3	Q4	Q5	Q6
Strongly disagree	8	13	15	11	26	3
Disagree	16	36	27	12	35	9
Neither agree nor disagree	33	32	24	30	24	26
Agree	51	34	42	57	28	59
Strongly agree	18	11	18	16	13	29

Table 5. Responses from participants using a neutrosophic scale

	Q1	Q2	Q3	Q4	Q5	Q6
Disagree	13	18	19	17	12	13
Neither agree nor disagree	59	70	61	59	73	43
Agree	54	38	46	50	41	70

Table 6. Answers based on Likert scale for all questions

	All Questions
Strongly disagree	6
Disagree	12
Neither agree nor disagree	55

Agree	44
Strongly agree	9

Table 7. Answers based on Neutrosophic scale for all questions

	All Questions
Disagree	8
Neither agree nor disagree	63
Agree	55

The total score for the express agreement options, namely agree and strongly agree, on the Likert scale was 53, while the cumulative score for the agree option on the Neutrosophic scale was 55.The Undecided option yielded a Likert scale score of 55 and a Neutrosophic scale score of 63. The aggregate of the responses "I disagree" and "I strongly disagree" on the Likert scale corresponds to a total of 18 individuals expressing disagreement. Conversely, on the Neutrosophic scale, this figure amounts to 8. Consequently, it is evident that the participants exhibited a significantly higher tendency to select the agree options in both scales. Moreover, the rates of agreement and undecided responses on the Neutrosophic scale surpass those on the Likert scale. Conversely, the Neutrosophic scale yielded lower results in the disagree options compared to the Likert scale. When assessed based on the ratios, it was observed that the participants provided a greater number of responses to the "I agree" alternatives. The Neutrosophic scale exhibited a greater inclination towards higher decision weights and a lesser inclination towards lower decision weights in contrast to the Likert scale.

This phenomenon can be elucidated by the fact that the Neutrosophic scale affords participants the opportunity to articulate their thoughts with greater clarity, as they are able to assign an unlimited number of points to each available option.

2. Statistical Analysis

The analysis involved the utilization of the SPSS 26.0 software package (IBM Corporation) and MATLAB R2015a to ascertain disparities between the two scales. To assess the construct validity of Likert and neutrosophic scales in measuring procedural justice and to uncover the factor structure, an Exploratory Factor Analysis (EFA) was conducted. The Kaiser-Meyer-Olkin (KMO) sampling fitness values were evaluated and found to be 0.758 and 0.768, respectively. These values indicate that the sample size was sufficient for exploratory factor analysis (EFA). According to Field [71] (p.647), it is necessary for this value to exceed 0.50. Furthermore, the Bartlett test yielded $x^2(15) = 295.919$ ($p < 0.05$) and $x^2(15) = 345.267$ ($p < 0.05$) for the respective variables. These results indicate that the variances across the variables are not homogeneous, providing support for the suitability ofthe data for exploratory factor analysis. The exploratory factor analysis (EFA) of the Likert scale yielded findings indicating that two scales, each comprising six items, exhibited a two-factor structure. These two factors accounted for 72.974% of the overall variance. Furthermore, the initial sub-dimension accounts for 49.293% of the variance, while the subsequent sub-dimension accounts for 23.681%. Similarly, based on the exploratory factor analysis (EFA) findings of the Neutrosophic scale, it was observed that the two scales, comprising six items each, exhibited a two-factor structure. These two factors accounted for 77.321% of the overall variance. Furthermore, the initial sub-dimension accounts for 51.255% of the variance, while the subsequent sub-dimension accounts for 26.066%. The distribution of Likert and neutrosophic scale items according to factors and their factor loadings is presented in Table 8 and Table 9, respectively.

Table 8. Factor analysis findings of Likert scale

Items	Factor1	Factor2
item4	0.894	
item1	0.868	
item3	0.859	
item6	0.800	
item2		0.855
item5		0.832

Table 9. Factor analysis findings of Neutrosophic scale

Items	Factor1	Factor2
item4	0.921	
item1	0.890	
item3	0.791	
item6	0.806	
item2		0.868
item5		0.909

As seen in Table 8 and Table 9, the first sub-dimension of both scales consists of 4 items (item4, item1, item3, item6), and the second consists of 2 items (item2, item5). The minimum value of factor loadings was determined as 0.791. Therefore, considering that factor loadings of 0.40 and above are considered ideal by Field [71], it was concluded that the items made a significant contribution to the factors.

Table 10 presents descriptive statistics covering 126 participants' evaluations of procedural fairness using two different scales (Likert and Neutrosophic).

Table 10. Descriptive Statistics

	Likert Scale	Neutrosophic Scale
Mean	19.540	1.415
Median	20.000	1.567
Mode	19.000	0.000
Std. deviation	4.414	1.983
Variance	19.482	3.931
Skewness	-0.539	-0.261
Std. error of skewness	0.216	0.216
Kurtosis	0.325	-0.598
Std. error of kurtosis	0.428	0.428
Range	24.000	8.000

Minimum	6.000	-3.000
Maximum	30.000	5.000

According to Table 10, the mean value and standard deviation of the Likert scale are lower than that of the neutrosophic scale. Additionally, skewness and kurtosis are important criteria to evaluate whether data distributions are normal. According to the skewness and kurtosis coefficients and the Kolmogorov Smirnov normality test (Table 11), it is observed that the Likert scale and the neutrosophic scale are different from the normal distribution at the 95% confidence level. However, in social sciences, it is considered ideal for skewness and kurtosis values to be in the range of [-1,1] [72]. Therefore, considering that the skewness and kurtosis values of both scales were in the [-1,1] range, parametric analyzes were performed assuming that they were suitable for normal distribution.

Table 11. Kolmogorov–Smirnov Test

	Kolmogorov–Smirnov		
	Statistic	**Df**	**Sig.**
Likert scale	0.086	126	0.022
Neutrosophic scale	0.075	126	0.079

Table 12. Cronbach's Alpha Values

Cronbach's Alpha Constant	**Variables**
0.787	SCORE1, SCORE2, SCORE3, SCORE4, SCIRE5, SCORE6
0.519	VAR1a, VAR2a, VAR3a, VAR4a , VAR5a, VAR6a
0.909	VAR1b, VAR2b, VAR3b, VAR4b, VAR5b, VAR6b
0.726	VAR1c, VAR2c, VAR3c, VAR4c, VAR5c, VAR6c
0.714	VAR1, VAR2, VAR3, VAR4, VAR5, VAR6

As seen in Table 12, Cronbach's alpha coefficient was calculated to evaluate the internal consistency and reliability of the scales. Likert and neutrosophic scales have generally been found to be highly reliable [73] (p.113).

Table 13. Correlation among Likert Items, Neutrosophic Items, and Scores

		VAR1a	**VAR1b**	**VAR1c**	**Score1**
	Correlation Coefficient	0.548 **	0.043	−0.268 **	0.244 **
VAR1	*p*	0.000	0.635	0.002	0.006
	N	126	126	126	126
		VAR2a	**VAR2b**	**VAR2c**	**Score2**
	Correlation Coefficient	-0.253 **	-0.017	0.283 **	-0.194 *
VAR2	*p*	0.004	0.854	0.001	0.030
	N	126	126	126	126
		VAR3a	**VAR3b**	**VAR3c**	**Score3**
	Correlation Coefficient	0.381 **	0.056	−0.115	0.143
VAR3	*p*	0.000	0.536	0.202	0.110
	N	126	126	126	126
		VAR4a	**VAR4b**	**VAR4c**	**Score4**
	Correlation Coefficient	0.532 **	0.006	−0.158	0.229 *
VAR4	*p*	0.000	0.951	0.077	0.010
	N	126	126	126	126
		VAR5a	**VAR5b**	**VAR5c**	**Score5**
VAR5	Correlation Coefficient	-0.410 **	-0.136	0.304 **	-0.191 *
	p	0.000	0.130	0.001	0.032

	N	126	126	126	126
		VAR6a	**VAR6b**	**VAR6c**	**Score6**
VAR6	Correlation Coefficient	0.339 **	-0.066	−0.256 **	0.239 **
	p	0.000	0.460	0.004	0.007
	N	126	126	126	126

* Correlation is significant at the 0.05 level. ** Correlation is significant at the 0.01 level.

According to the Spearman correlation analysis results in Table 13, there is a generally positive significant relationship between the Likert scale item and the "agree" item of the neutrosophic scale, and between the Likert scale item and the scores obtained from the neutrosophic scale items (except VAR2 and VAR5). Since var2 and var5 items were reverse coded, there is a negative relationship between them and the Neutrosophic scale.

According to the findings in Table 14, it was observed that there was a very weak or even almost no relationship between the Likert and neutrosophic scales.

Table 14. Correlation between Neutrosophic Scale and Likert Scale

		Neutrosophic Scale
Likert scale	Pearson Correlation (r)	0.055
	p	0.540
	N	126

Table 15. Paired Samples T-Test

		Me.an	**SD**	**t**	**Df**	***p***	**d**
Pair 1	Likert scale-Neutrosophic scale	18.125	4.738	42.941	125	0.000	3.825

d = Effect size.

As indicated by the findings in Table 15, the paired samples t-test yielded significant results, indicating a notable disparity between the Likert scale and Neutrosophic scale ($t = 42{,}941$, $p < 0{,}05$). According to Cohen's criteria, the effect size (3.285) was found to be notably large [74].

Mean and standard deviation are measurements that form the basis of statistical analysis. In Table 15, the means and standard deviations of participants' attitudes towards procedural justice were determined through Likert and neutrosophic scales.

Table 16. Mean and Standard Deviation of the Likert Scale and Neutrosophic Scale

Item	**Likert Scale**		**Neutrosophic Scale**	
	μ	**σ**	**μ**	**σ**
There are effective procedures in place to help students solve problems.	3.437	1.084	0.247	0.462
It is not clear what to do when a student has a problem.	2.952	1.151	0.153	0.477
There is an effective system for lodging complaints of unfair treatment.	3.167	1.257	0.202	0.483
Students can get the advice or help they need.	3.437	1.106	0.222	0.477
There is no point in complaining as nothing will really be done.	2.738	1.297	0.191	0.465
Educational information is provided to students in an easily accessible way.	3.810	0.953	0.400	0.485

μ = Arithmetic mean, σ = Standard deviation.

The results in Table 16 show that the sample mean and standard deviation of the data obtained with the Neutrosophic scale are lower than the sample mean and standard deviation of the data obtained with the Likert scale. Lower mean and standard deviation indicate that the scales provide

more consistent and similar results about the measured trait or concept and that the data set has a more homogeneous distribution. In this context, it can be stated that the neutrosophic scale data has a more homogeneous distribution than the Likert scale.

Table 17. One-Way ANOVA Findings for the Likert and Neutrosophic Scales

Scale	Effect	Mean Square	F	Significance Level
Likert scale	Age	74.295	4.204	0.003
Neutrosophic scale	Age	10.130	2.719	0.033

As shown in Table 17, one-way ANOVA was conducted to examine the single effect of age groups. The effect of age groups on the Likert scale and neutrosophic scale was statistically significant (respectively, F = 4.204, $p < 0.05$; F=2.719, $p < 0.05$). On the Likert scale, the difference between the averages of the 22-24 age group and the 25-30 age group was found to be statistically significant ($p < 0.05$). The Likert scale score of students in the 25-30 age group (Mean = 22.208) is higher than that of students in the 22-24 age group (Mean = 18.404).

The fact that students in the 25-30 age group have more life experience compared to students in the 22-24 age group enables them to have more realistic expectations and can be explained by their more accepting behavior towards institutional procedures.

Table 18. Two-Way ANOVA Findings for the Likert and Neutrosophic Scales

Scale	Single and Interaction Effect	Mean Square	F	P
Likert scale	Gender	10.615	0.531	0.468
	Faculty	17.515	0.876	0.539
	Gender X Faculty	13.404	0.670	0.697
Neutrosophic scale	Gender	1.179	0.314	0.576
	Faculty	7.888	2.101	0.042
	Gender X Faculty	0.826	0.220	0.980

Two-way ANOVA was performed to investigate both the individual impacts and the interaction impacts between gender and faculty (Table 18). The individual effect of gender (F = 0.531, $p > 0.05$), individual effect of faculty type (F = 0.876, $p > 0.05$) and the interaction effect of gender andfaculty type (F = 0.670, $p > 0.05$) on the Likert scale were statistically insignificant.

Likewise, the single effects of gender (F = 0.314, $p > 0.05$) and the interaction between gender and faculty type (F = 0.220, $p > 0.05$) on the Neutrosophic scale were not statistically significant. However, the individual effect of the student's faculty type on the Neutrosophic scale was statistically significant (F = 2.101, $p < 0.05$).

The statistical analysis revealed a substantial individual influence of faculty type on the Neutrosophic scale. This problem can be attributed to variations in procedures across different faculties or disparities in student perception resulting from the administrators' application approach.

It can be thought that the fact that students in the 25-30 age group have more life experience than students in the 22-24 age group enables them to have more realistic expectations, and this causes them to exhibit more accepting behavior towards institutional procedures.

3. Conclusions

This study explores the differences and comparative effectiveness of the Likert and Neutrosophic scales in assessing aspects of organizational behavior and justice. The results of the

study exhibit a multitude of dimensions, illustrating the intricate relationship among several factors such as scale type, answer clarity, dependability, demographic variables, and statistical approaches.

An important finding of this study is that the Neutrosophic scale offers greater decision-making significance when compared to the conventional Likert scale. The architecture of the Neutrosophic scale allows respondents to flexibly allocate points across alternatives, resulting in a more precise expression of their ideas and preferences. This particular attribute becomes advantageous in obtaining subtle and nuanced replies that would be diminished or concealed by the more limited Likert scale approach. The findings of our study revealed that responses collected using the Neutrosophic scale not only had high mean values and standard deviations, but also exhibited uniformity and consistency across different data sets. These results suggest that the Neutrosophic scale is a more dependable and consistent measure when subjected to different analytical settings.

Regarding reliability, it is noteworthy that both scales exhibited a strong level of internal consistency, as indicated by the substantial Cronbach's alpha coefficients. This observation highlights the usefulness of both measures in academic and applied research contexts, however the Neutrosophic scale is acknowledged for its enhanced ability to capture comprehensive respondent response with greater clarity.

Exploratory factor analysis provided further analytical depth, revealing that both scales consist of two separate sub-dimensions. It is noteworthy that the two dimensions in both scales consisted of identical items, namely initial dimension item4, item1, item3, and item6, the second dimension was comprised of item2 and item5. In contrast to the Likert scale, the Neutrosophic scale did not necessitate the reverse coding of any items, including of items 2 and 5. This feature has the potential to decrease the intricacy and the likelihood of misinterpretation, hence improving the scale's practicality and precision.

Additionally, our research investigated the significance on scales of demographic factors, including age and faculty type. The results of the one-way analysis of variance (ANOVA) revealed statistically significant variations in responses across different age groups on both scales. Specifically, it was seen that those between the ages of 25 and 30 exhibited greater scores on the Likert scale compared to those in the 22-24 age range. Additionally, the two-way ANOVA revealed that the kind of faculty had a notable influence on responses on the Neutrosophic scale, but not on the Likert scale. The results of this study indicate that demographic variables might have varying effects on the results of research, depending on the scale employed. Therefore, it is crucial to carefully choose the proper measuring instrument while doing organizational research.

The lack of association between the Likert and Neutrosophic scales, as observed in our data, highlights the unique assessment capabilities of each scale. The absence of a correlation highlights the necessity for researchers to carefully select a scale that is most suitable for their particular study needs and goals.

In summary, this research makes a valuable contribution to the continuing scholarly conversation surrounding the efficacy of measurement scales in the field of organizational research. The Neutrosophic scale, due to its enhanced adaptability and more transparent response mechanism, presents a viable substitute for the conventional Likert scale, especially in research that necessitates meticulous examination of intricate behaviors and attitudes. Further investigation is warranted to examine these scales in diverse settings and with distinct demographic groups in order to comprehensively determine their suitability and efficacy across a wider array of academic fields.

In a prospective future investigation, our intention is to employ machine learning models for the purpose of forecasting demographic variables, including age, education, marital status, and sex, based on the responses obtained from the classical Likert and Neutrosophic Likert scales. Another potential avenue for future research involves utilizing the recently developed RANCOM method, which specifically targets the assessment of Neutrosophic Likert scale data by experts in various fields [75].

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