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Fuzzy Modelling of Tourist Motivation: An Age-Related Model for Sustainable, Multi-Attraction, Urban Destinations

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Abstract: Tourist motivation, as a core of travel behavior, significantly influences consumer intentions and has attracted academic attention for decades. A plethora of studies analyse sets of internal and external motivators, while methodologies that exclusively focus on a single factor, such as age, that can sometimes have a determining influence in multi-attraction destinations, are less prevalent. This study introduces a fuzzy logic approach to develop a new model for analysing the internal motivations of different-aged consumers in multi-attraction urban destinations. Fuzzy models, as a mathematical means of representing vagueness and imprecise information, have the capability of recognizing, representing, manipulating, interpreting, and utilizing data and information, which typically for urban tourist motivations, are vague and lack certainty. This research tests the model in a real-life setting, using the example of Novi Sad, a mid-sized European city, which is typical of many similar cities who are attempting to develop sustainable tourism by attracting older tourists. The new model shows how tourist motivations for multi-attraction destinations are affected by age, through a specially developed m-file for MATLAB, so that it can be applied and tested in other tourism contexts. Theoretical and practical implications for sustainable destination management and marketing are described.

Keywords: tourist motivation; age; fuzzy modelling; urban destination; sustainable urban tourism; overtourism

1. Introduction

Tourist motivation can be regarded as the essence of travel behaviour since it significantly drives behavioural intentions [1,2]. Scholars consider motivation as the internal force which influences most tourist activities [3,4]. For single attraction destinations such as Santa Claus Village in Lapland, Finland, tourist motivations are straightforward and correspond with expected behaviours in the destination. For destinations with multiple attractions, understanding tourist motivations is more complex [5]. This complexity is typical for urban destinations comprised of a mix of historical places, monuments, museums and art galleries, buildings and other architectural structures, parks, events and festivals, night-time entertainment and a range of other services that interlink with the tourism offer.

Many heritage tourism destinations in Europe have faced problems with overtourism and sustainable development in recent years, including physical impacts such as environmental degradation, overcrowding, and unsustainable water usage, but also a rise in anti-tourism sentiment amongst residents, poor destination image and, in extreme cases, protests and outmigration of locals [6,7]. In response to this, many cities have sought to diversify their tourism offer away from high-volume, low value tourism [8,9], and to attract older tourists, who they believe will be more responsible visitors who can make a more positive contribution to sustainable development. Strategies to achieve this have included: product diversification and development, especially involving cultural heritage tourism, marketing and de-marketing campaigns aimed at changing the demographic composition of visitors, and traditional destination management techniques such as dispersal and public information campaigns aimed at changing tourist behaviour. Although the success of these attempts has been well-researched in terms of issues such as carrying capacity [10], smart tourism [11], and marketing [12], the motivations of different age groups of tourists to these types of multi-attraction destinations have not been the subject of inquiry in this context.

This research explores the motivations of different age groups of tourists so that destination management organisations (DMO) can create more targeted marketing campaigns and engage in suitable product development and diversification activities, to maximise the contributions of tourism to sustainable development, and to reduce the negative impacts of overtourism. Although there are a range of factors which influence tourists' motivation to travel, for multiple-attraction destinations, age can be regarded as a constant factor in a situation where the complex interplay of push and pull motivations [5] related to diverse attractions makes it difficult to isolate individual factors.

Various studies have examined tourist motivation for urban destinations. Frequently, motivation is set within a broader research inquiry, where it is connected to age, gender, nationality and other sociodemographic characteristics [13,14]. Studies have shown that gender and age significantly affect the choice of tourism destinations [15–18]. Research on how age influences motivation is well established [13–18], but studies focusing solely on the influence of age on tourist motivation are rare, especially in the case of multi-attraction urban destinations where additional insight is needed for comprehensive tourism policy making. As shown in tourist consumer life cycle and generation studies [19,20], determining the influence of age on tourist motivations is of a paramount importance for tourism companies, but it is mostly overlooked in tourism destination management and marketing studies that are often too generic. One of the reasons for this could be the limited methodological approaches in tourism research that can be used to capture and measure changing age-related consumer motivations in relation to the complex nature of urban destinations.

As [21] explained in an early paper on fuzzy methods and tourism, conventional statistical techniques are not adequate for capturing the important qualitative and often uncertain knowledge used by tourism managers in their decision making, and more 'common-sense' analysis approaches are needed to contribute to problem solving in the industry. Fuzzy models, as a mathematical means of representing vagueness and imprecise information are capable of recognizing, representing, manipulating, interpreting, and utilizing data and information that, typically for tourist motivations to visit urban destinations, are vague and lack certainty. In tourism research, fuzzy models have been used in situations where the behavioural and purchase intentions of tourists are complex and take place in dynamic environments [22–24], where tourist decision making involves a wide range of diverse options, such as with hotel selection and evaluation [25], to understand the complexity of tourist satisfaction [26–28], and to aid decision making in areas of strategic management [29,30]. There has been some application of fuzzy models to tourist motivation [31,32], but this is an area of research that is currently under-developed.

To this end, the aim of this exploratory study is to use a fuzzy logic approach to develop a model for exploring the motivations of all-age consumers in urban destinations. It is based on data acquired at a multi-attraction urban destination, the typical mid-size central European city of Novi Sad, in Serbia. The contribution of this research is twofold. First, it introduces a new methodology into research on

tourist motivation by applying the fuzzy concept to analyse the motivations of different-age consumers. The advantages of using a fuzzy model of tourist motivation for a single category, such as age, are that fuzzy measures can be used to model the interaction between different motivational factors, to help to develop knowledge about potential mutual boosts between groups of factors in complex urban destinations. Secondly, it applies the model in a real-life setting to test its applicability to the case of Novi Sad, and to develop practical recommendations for destination management and marketing.

2. Theoretical Background

2.1. Tourist Motivation

Tourist motivation consists of needs that predispose a person towards a certain activity [33]. The phenomenon has been studied extensively in the last five decades [34–38] and is not a new research paradigm. Previous studies have frequently focused on tourist behaviour as an essential element for understanding the decision-making process in the choice of destinations and holiday types [34,39,40], or as the basis for assessing the level of satisfaction that is derived from tourist experiences [41–44].

The concept of push and pull factors has been used in many studies [34,45,46] to explain tourist motivations. The push-pull approach argues that people travel because they are "pushed" into making decisions by internal forces—desires for escape, rest, relaxation, prestige, health and fitness, adventure, and social interaction, as suggested by [46]; and "pulled" by external forces, including destination attributes (e.g., beaches, parks, and other amenities and characteristics of destinations). Ref. [47] suggested that push motives are intrinsic motives that relate to the individual, whereas pull motives are connected to the destination. Despite the range of different approaches that have been developed to explain tourist motivations, the push-pull theory tends to be one of the most widely referred to in the tourist motivation literature [48–51]. Although some authors have begun to reconsider the complex interactions and relationships that exist between push and pull factors [41,52–54], it is generally observed that they relate to two separate tourist decisions made at two separate points in time—one focusing on whether to go or not, and the other on where to go. Therefore, push factors are perceived to be present in the decision-making process before pull factors [55], and as such they are the focus of this research.

The Leisure Motivation Scale [56] was used within this exploratory study. This was derived from the work of [57] and further tested and replicated by other authors, for example by [58–61]. One of the major contributions to the model can be found in the work of [62] who demonstrated the stability of the motivational factors through longitudinal research assessing mean scores, rankings, and the persistence of factor loadings. The factors defined in the model are, firstly, an intellectual motive which "assesses the extent to which individuals are motivated to engage in leisure activities which involve mental activities such as learning, exploring, discovering, thought or imagining". Second, a social component assesses the extent to which individuals engage in leisure activities for social reasons. This component includes two basic needs, the need for friendship and interpersonal relationships, and the need for the esteem of others. Third, there exists a competence-mastery component in which individuals seek to achieve, master, challenge, and compete. Finally, there is a stimulus/avoidance motive which "assesses the drive to escape and get away from over-stimulating life situations. It is the need for some individuals to avoid social contacts, to seek solitude and calm conditions; and for others it is to seek to rest and to unwind themselves" (p. 225 [56]).

The connections between age and internal motivations can be found in previous tourism research, explored in relation to a wide range of topics, such as understanding the travel decision-making processes among senior groups [63,64], in particular comparing the travel behaviours of senior tourists with those of younger tourists [65,66]. The relationship between motivation and age, especially in relation to satisfaction, has been argued in several studies [45,67]. Some studies have tried to explain why seniors travel and why not [68], later connecting the research topic to the characteristics of the Baby Boomer generation [69,70], and adding some psychological variables to the research, as factors

influencing travel decisions [71,72]. The majority of current studies on senior tourists are focused on the motivations of seniors who travel for pleasure and for other reasons excluding business [73]. In addition to senior tourist research, Ref. [74] investigated Baby Boomers and their motivations towards adventure tourism. Additionally, a recent study examined Millennials and travel behaviour trends in six different case studies [75].

Studies that have investigated why travel motivations appear to change over time have often used the Travel Career Ladder model [76] to explain the influence of increasing levels of individual experience of travel on the development of internal motivations, with tourists developing more complex motivations linked to their own psychological fulfilment as their experience of travel grows. This has also been linked to the idea of the Travel Life Cycle (TLC) [77], with [78] noting the lack of consensus in the literature on the TLC about the precise influence of age on travel motivation, but suggesting that it is not simply the dynamics of changing family life cycles that determine changes in travel motivations as tourists age.

Although age is almost universally considered as a demographic consideration when analysing tourist motivation, it is primarily used to characterise respondents in primary research, rather than as an influencing factor in motivation. Where age is considered, findings suggest that the influence of age on tourist motivation is highly variable. For instance, when analysing the motivations of tourists to Turkey, Ref. [14] found no significant effect of age, despite emphasizing the importance of other socio-demographic factors in understanding tourist motivations. In contrast to this, Ref. [79] identified a significant age-related difference in tourist motivations to Barbados, linking this to changing preferences for sports and physical activities over a tourist's life. Ref. [80] used data from surveys carried out in 2008 and 2012 to analyse the motivations of Chinese tourists to the Australian city of Cairns and found that age had a significant relationship to the importance of push and pull factors in 2012, but not in 2008, although cultural factors had a consistent influence across both years.

Multiple studies split tourists into senior and non-senior tourists and identify differing motivations between these broadly defined groups, although these simple categorizations have also failed to produce consistent findings on the influence of age on motivations. For example, Ref. [81] showed that, for thalassotherapy tourists, motivations across the two age groups could be differentiated in terms of their relationship to income levels, distance travelled, and education, with the over 55s being less influenced by their income constraints, but more heavily influenced by the distance involved in travel to a destination and the educational aspects of the trip. Kaufman and Weaver [82] however, found that seniors were more likely to visit heritage destinations that involved a long journey when compared to younger people. The ambiguities in the analysis of the influence of age on travel motivation suggest the need for further research in this area. Despite everything written to date, age is rarely perceived as a comprehensive and complex category in itself, and thus researched in such a manner. Mostly, age has been examined in terms of how a particular group of tourists' travel behaviours can be understood, not as an influencing factor in and of itself, in terms of its relationships with other motivational factors, which is the aim of this research. Additionally, most examples of age-related motivation research look at very specific types of niche tourism, or tourism where very specific pull-factors are apparent and where it is easier to single out specific motivations for comparison. In multi-attraction urban destinations, motivations are multiple and mixed, and a fuzzy approach helps to understand these, to which end a new mathematical model has been developed for this research.

In order to test this new fuzzy logic approach, this research analyses the relationship between age and internal tourist motivations in a multi-attraction urban destination, in order to develop insights of value for future research and for urban tourism professionals.

2.2. Tourist Motivation and Multi-Attraction Urban Destinations

Cities are places of maximum concentration of power and national culture [83]. There are many studies on tourist motivation focusing on different aspects of multi-attractive urban spaces [84–86]. For instance, Ref. [87] gave an important early perspective on urban tourism and motivations for

visitation and found that cities are places with high population density, therefore one of the most dominant motives was visiting friends and relatives (VFR). Ref. [88] examined tourist motivations for visiting cities and showed that the most important motives were shopping, conferences and exhibitions, VFR, education and culture and heritage. Ref. [89] found that the primary motivation for travel to urban destinations could often be a visit to a museum or attending a concert. Some authors present arguments about the complexity of understanding travel to urban destinations. Ref. [90] perceived cities as multi-dimensional and multi-functional and stated that tourist motivations for cities have to be researched and viewed in the same way. In some recent studies on urban destinations, researchers have also labelled shopping as a powerful motive for travel and choice of destination [91,92]. Refs. [93,94] discussed and investigated destination image and the depth of influence it has on tourist motivation, showing the complex ways in which push factors are combined in influencing destination choice.

3. Methodology

In this section, an explanation of the fuzzy motivational model that was developed for this research is given, as well as the sample that was used and the method of analysis. Supplementary Materials is presented alongside this paper in the form of an original MATLAB script which was developed specifically for this research and which forms part of its contribution to the literature on tourist motivation. The results and discussion section which follows presents the full procedure that was enabled by this script, with the steps of the fuzzy logic procedure presented in a step-by-step fashion alongside their results.

3.1. Case Study Area

Novi Sad is a conglomeration of 15 suburban settlements that make up the second largest city in Serbia, with a population of 360,925 [95]. It is situated on the Danube river and two major international road travel corridors also pass through the city. Tourism to Novi Sad has been growing over the past decade, with tourist arrivals rising from 89,633 in 2013 to 156,826 by 2018, which includes 313,025 overnight stays [96,97]. As a complex, multi-attraction destination typical of many mid-size European cities, the city contains a wide range of different attractions for tourists, with its most famous site being the Petrovaradin Fortress, a complex of tangible cultural heritage embodying a complex military fortification system, built throughout the 17th and 18th century. As well as this highly visible landmark, Novi Sad has a retail and entertainment offer including shops, museums and galleries and a wide programme of events and festivals. It is also adjacent to the national park "Fruška Gora", which has been established as a tourist site for more than fifty years and provides access to numerous wineries, farmsteads, and other rural tourism attractions [97].

The most significant attraction of Novi Sad, in terms of tourist numbers, is the annual "Exit Festival". This festival was founded in 2000 as a local event and has grown every year to now attract more than 30,000 international visitors [98,99]. In total, the festival has received more than 2.5 million international visitors, from more than 60 countries [100]. Capacity built through the experience of the Exit Festival has helped Novi Sad to develop a more diverse events portfolio [101] to support its wider development ambitions [102], which now sees the city hosting business events as well as international sports events [103]. Recently, Novi Sad was the European Capital of Youth Culture in 2019 [104] and will be a European Capital of Culture in 2022 [97].

3.2. Fuzzy Logic Instrument Design

The authors applied Beard and Ragheb's [56] Leisure Motivation Scale (Table 1), as an approach that does not favour external variables [105] and that exhibits high reliability and validity as shown in by previous studies in tourism [61,106]. Beard and Ragheb's scale is one of the most commonly used for examinations of leisure motivation. It has four dimensions that can be satisfied through leisure travel: namely, an intellectual motive (learning, exploring, discovering, reflecting or imagining),

a social motive (the need for friendship and interpersonal relationships, the esteem of others), a competence-mastery motive (achieving, mastering, challenging, and competing) and a stimulus avoidance motive (the need to escape and get away) [56]. Later, Ref. [61] adapted the Beard and Ragheb scale for tourism purposes by extracting four motives: social, relaxation, intellectual and competence-mastery dimension. A similar approach was used later in further scales, such as [107] study that relies on culture, pleasure-seeking, relaxation and physical motivations. In tourism literature, Fodness' Tourist Motivational Scale [108] is also frequently used, intending to measure the functions that travelling serves for tourists: Knowledge, Utilitarian (Punishment Minimization), Social Adjustive, Value-Expressive, Utilitarian (Reward Maximization). Here, the Knowledge function is clearly related to an intellectual motive. In contrast, the Value-Expressive and Social Adjustive constituents relate to the need for the esteem of others, which is a portion of the social dimension of Beard and Ragheb's study, indicating its foundational role.

This research uses the fuzzy model with time dependent matrices presented in the work of [109]. A detailed explanation of this model is presented in the results section, where the step-by-step process is introduced and explained. A set of indicators (Table 1) proposed by [56] were applied that are capable of covering various aspects of multi-attraction destinations. The model employed in this research was developed by [56], which is based upon previous research by various authors [110–113]. The model is divided into four factors which influence internal motivation: Intellectual, social, competence/mastery and stimulus/avoidance, which are described through 32 items (M stands for motivational item/factor within all further tables), which is shown in Table 1.

Table 1. Tourist motivations by Beard and Ragheb (1983).

	Intellectual Factors	Social Factors	Competence/ Mastery Factors	Stimulus/Avoidance Factors
M1	to learn about things around me	to build friendships with others	to challenge my abilities	to slow down
M2	to satisfy my curiosity	to interact with others	to be good in doing them	because I sometimes like to be alone
M3	to explore new ideas	to develop close friendships	to improve my skill and ability in doing them	to relax physically
M4	to learn about myself	to meet new and different people	to be active	to relax mentally
M5	to expand my knowledge	to reveal my thoughts, feelings, or physical skills to others	to develop physical skills and abilities	to avoid the hustle and bustle of daily activities
M6	to discover new things	to be socially competent and skilful	to keep in shape physically	to rest
M7	to be creative	to gain a feeling of belonging	to use my physical abilities	to relieve stress and tension
M8	to use my imagination	to gain others' respect	to develop physical fitness	to un-structure my time

3.3. Fuzzy Logic Procedure

After the selection of the indicators, the second phase of the research started, which included data collection. The input data (indicators) for the fuzzy method were collected from 151 tourists of different age groups who visited the Tourist Information Centre of the Novi Sad DMO during 2017. A feature of the mathematical approach that uses fuzzy sets to generate new insights is that a relatively small sample size is adequate for carrying out the mathematical modelling, and comparable size

samples have been used in previous related research in tourism [22,23,27]. All tourists were thoroughly informed about the purpose of the research. Respondents voluntarily participated and were informed that the research was anonymous. The survey was carried out in English.

Tourists were asked to select the most dominant internal motives which best described their internal forces when travelling to urban destinations. As explained, the model consisted of 32 items equally distributed among four factors, which were presented in random order in the survey list, to avoid first choice offer bias [114]. In order to analyse the data, the answers were later grouped into the four factors and transferred into a raw data matrix.

Finally, the data set was analysed in MATLAB and an original script was developed for MATLAB 7.12.0.635 (R2011.a) (see the Supplementary Materials for this manuscript). The first phase was the transformation of data into an Excel matrix with raw data, named the Age Dependent (AD) Matrix and defined by certain age intervals. The AD matrix was then used for further analysis, which led to plotted charts based on Refined Age Dependent Data (RAD) and Combined Effect Age Dependent Data (CEAD) matrix (see Section 4).

3.4. Fuzzy Logic Input Data

The input data for the fuzzy model is presented in Table 2, showing a broadly equal distribution by gender, with 53.6% male and 46,4% female tourists. The average age is 37.05 years, and the SD is 11.827, showng that there is a wide variation of age amongst tourists in the sample, with the youngest being 17 years old and oldest being 84 years old. This range was important for this research which aimed to explore the influence of age on motivations. Normality tests within the age distribution calculated a Skewness value > −1 and a Kurtoisis value < 1, proving normal distribution.

Table 2. Input data characteristics.

Age		**Gender (%)**	
Average	37.05	Male	53.6
SD	11.827	Female	46.4
Skewness	0.983	**Nationality (%)**	
Kurtoisis	1.089	Western Europe	11.3
Income (%)		Northern Europe	5.3
0–100 €	3.3	Middle Europe	33.1
100–300 €	2.0	South Europe	29.8
301–500 €	6.0	Eastern Europe	4.6
501–700 €	6.6	Asia	2.0
701–900 €	11.3	Americas	10.6
Above 900 €	53.0	Australia and Oceania	3.3
Missing data	17.9		

Income levels had a fairly unequal distribution with the largest percentage (53%) having above 900€ income. In future research, a broader scale could be applied, further increasing the upper threshold to allow for greater differentiation in responses between higher income groups.

4. Results and Discussion

4.1. Overlapping Different Age Groups with Intellectual Factors

All collected data were transferred into the raw matrix in the form of an excel spread sheet, which was used for Age Dependent (AD) matrix development, shown in Table 3.

Table 3. Age Dependent (AD) matrix 5 x 8 for intellectual factors (M—motivational item/factor).

Age	M1	M2	M3	M4	M5	M6	M7	M8
15–25	19	15	18	11	16	19	3	6
26–32	26	24	24	11	26	28	11	9
33–40	18	21	23	7	15	24	13	8
41–49	15	11	12	6	11	18	7	4
50–70	12	17	9	6	12	12	3	2

In Table 3, the rows show the age groups and columns corresponding to the internal motives. The tested intellectual factors were defined by eight items (Table 1), which are represented by the AD matrix columns, while rows are represented by different age intervals, formed into five groups (Table 2). The next phase was the transformation of the AD matrix into an Average Age Dependent Data (AAD) matrix (Table 4). Every cell of AD matrix a'_{ij} was divided by the length of age interval b_i (breach) where i was a certain row and j was a certain column of matrix (for this matrix i = 1, . . . , 5, a j = 1, . . . , 8). The age interval b_i was obtained through the difference of interval length, to which 1 was added (example $b_1 = 25 - 15 + 1 = 11$). Every cell for the AAD matrix was calculated through the formula $\frac{a'_{ij}}{b_i}$ (*exmp.* $a_{13} = \frac{a'_{13}}{b_1} = \frac{18}{11} \approx 1.64$), the ratio between the number of respondents and age interval length.

Table 4. Average Age Dependent Data (AAD) matrix 5 × 8 for intellectual factors.

Age	M1	M2	M3	M4	M5	M6	M7	M8
15–25	1.73	1.36	1.64	1	1.45	1.73	0.27	0.54
26–32	3.71	3.43	3.43	1.57	3.71	4	1.57	1.29
33–40	2.25	2.62	2.87	0.87	1.87	3	1.62	1
41–49	1.67	1.22	1.33	0.67	1.22	2	0.78	0.44
50–70	0.57	0.81	0.43	0.29	0.57	0.57	0.14	0.09

The next phase was the calculation of the Arithmetic Mean (AM) and Standard Deviation (SD) of every column in the AAD matrix.

In both cases j = 1, . . . , 8 and m = 5 (Table 5).

Table 5. Arithmetic Mean (AM) and SD for Intellectual AAD matrix.

-	M1	M2	M3	M4	M5	M6	M7	M8
AM	1.99	1.89	1.94	0.88	1.76	2.26	0.88	0.67
SD	1.14	1.09	1.21	0.47	1.18	1.30	0.70	0.47

This was then followed by a phase of transformation of the AAD Matrix to the Refined Age Dependent Data (RAD) matrix, a fuzzy matrix consisting of elements e_{ij} here was $e_{ij} \in \{-1, 0, 1\}$. Using the AM of each j^{th} column and SD of each j^{th} column, a parameter α from the interval [0, 1] was chosen and the Refined Time Dependent Data matrix (RTD matrix) (e_{ij}) was formed using the formula:

$$e_{ij} = \begin{cases} -1, & \text{if } a_{ij} \leq \mu_j - \alpha * \sigma_j \\ 0, & \text{if } a_{ij} \in \mu_j - \alpha * \sigma_j,\ \mu_j + \alpha * \sigma_j \\ 1, & \text{if } a_{ij} \geq \mu_j + \alpha * \sigma_j \end{cases}$$

where a_{ij} was an element of the AAD matrix. The values obtained here for e_{ij} depend on the position of values from the AAD matrix. If a value a_{ij} is the close proximity, given by the parameter alpha and SD, to the corresponding arithmetic mean, then e_{ij} can be considered to be neutral ant it has value 0. If the value of a_{ij} is outside this proximity area, the value of e_{ij} is 1 or −1, depending on whether it is bigger or smaller than this proximity area.

Once the RTD matrix was defined, raw RTD was calculated through the formula:

$$s_i = \sum_{j=1}^{8} a_{ij}, \tag{2}$$

where is e_{ij} were the values of the RTD matrix. Values s_i are the values of the raw RTD matrix, and are sums of the rows of the RTD matrix.

The values of the raw RAD matrix were used for transformation into the Combined Effect Age Dependent Data Matrix (CEAD) matrix by applying different α parameters from the range [0, 1], transformed values were used for the plot values shown in Figure 1.

RTD matrix 5×8 for $\alpha = 0.15$ Raw RTD matrix

$$\begin{bmatrix} -1 & -1 & -1 & 1 & -1 & -1 & -1 & -1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 0 & 0 & 1 & 1 & 1 \\ -1 & -1 & -1 & -1 & -1 & -1 & 0 & -1 \\ -1 & -1 & -1 & -1 & -1 & -1 & -1 & -1 \end{bmatrix} \begin{bmatrix} -6 \\ 8 \\ 6 \\ -7 \\ -8 \end{bmatrix}$$

RTD matrix 5×8 for $\alpha = 0.35$ Raw RTD matrix

$$\begin{bmatrix} 0 & -1 & 0 & 0 & 0 & 0 & -1 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 0 & 1 & 1 & 0 & 0 & 1 & 1 & 1 \\ 0 & -1 & -1 & -1 & -1 & 0 & 0 & -1 \\ -1 & -1 & -1 & -1 & -1 & -1 & -1 & -1 \end{bmatrix} \begin{bmatrix} -2 \\ 8 \\ 5 \\ -5 \\ -8 \end{bmatrix}$$

RTD matrix 5×8 for $\alpha = 0.45$ Raw RTD matrix

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ -1 & -1 & -1 & -1 & -1 & -1 & -1 & -1 \end{bmatrix} \begin{bmatrix} -1 \\ 8 \\ 2 \\ 0 \\ -8 \end{bmatrix}$$

RTD matrix 5×8 for $\alpha = 0.75$ Raw RTD matrix

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ -1 & -1 & -1 & -1 & -1 & -1 & -1 & -1 \end{bmatrix} \begin{bmatrix} -1 \\ 8 \\ 2 \\ 0 \\ -8 \end{bmatrix}$$

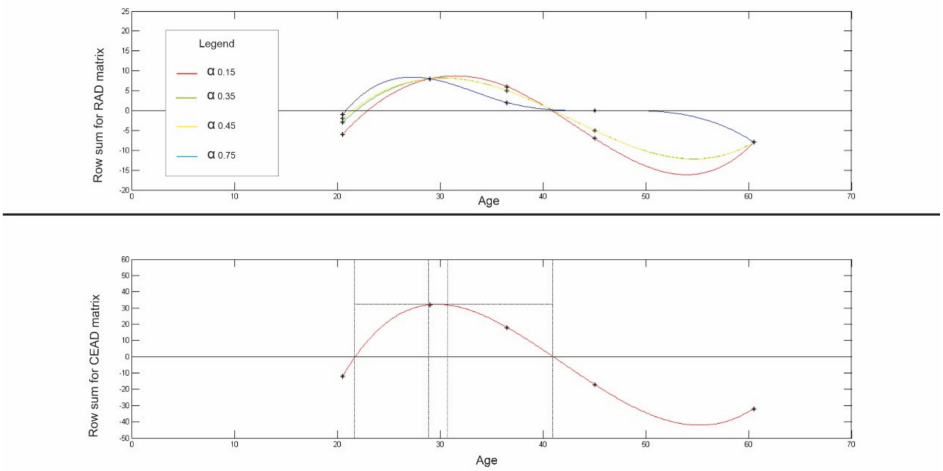

Figure 1. Age influence on intellectual factor using Refined Age Dependent Data (RAD) and Combined Effect Age Dependent Data (CEAD) matrix.

After obtaining the RTD matrix values, the CEAD matrix was calculated, formed by the cumulative effect of raw sums of every RTD matrix for different value of $\alpha \in [0, 1]$. The raw CEAD matrix was used for final chart plot, thus defining function limits (Figure 1).

$$\underset{\text{CEAD matrix } 5 \times 8}{\begin{bmatrix} -1 & -2 & -1 & 1 & -1 & -1 & -4 & -1 \\ 4 & 4 & 4 & 4 & 4 & 4 & 4 & 4 \\ 1 & 2 & 3 & 0 & 0 & 2 & 4 & 3 \\ -1 & -2 & -2 & -2 & -2 & -1 & 0 & -2 \\ -4 & -4 & -4 & -4 & -4 & -4 & -4 & -4 \end{bmatrix}} \underset{\text{Raw CEAD matrix}}{\begin{bmatrix} -10 \\ 32 \\ 15 \\ -12 \\ -32 \end{bmatrix}}$$

Based on Figure 1, it can be concluded that intellectual factors play a very dominant role at the age of 29 until the age of 30, thus being most influential on travel behaviour during that life span. Furthermore, they emerge as significant factors affecting travel decisions at the age of 22, and at the age of 41 they begin to decline and to lose the influence. These assumptions were confirmed by the CEAD matrix.

Intellectual factors start to influence decision making at the age of 21, which can be connected to the education-related motivations of the individual. Ref. [115] presented the wide variety of resources in cities, which can be linked to pull motives, including historic monuments, museums, and galleries, promoting the learning activity of an individual. Museums and galleries have changed from static places into active learning environments for children and adults as they are placing their visitors and school groups at the centre of their activities [116]. Tourists who are most frequently interested in cultural motives are also interested in education, and this synergy of motives has been named as "self-improvement", as it is connected with a desire to increase and extend existing knowledge, learn new things, and experience different cultures [37].

4.2. Overlapping Different Age Groups with Social Factors

This section analyses the social factors and their impact on different age groups regarding the decision-making process within travel to urban destinations. The analysed social factor includes eight items (Table 1). As presented in Figure 2, the social factor plays the most dominant role within the age group from 29 to 35 years old. The social factor starts to emerge as a significant factor influencing the decision-making process from 21 years old, while it loses its importance, and then stops, at the age of 43. These results are confirmed by the CEAD matrix.

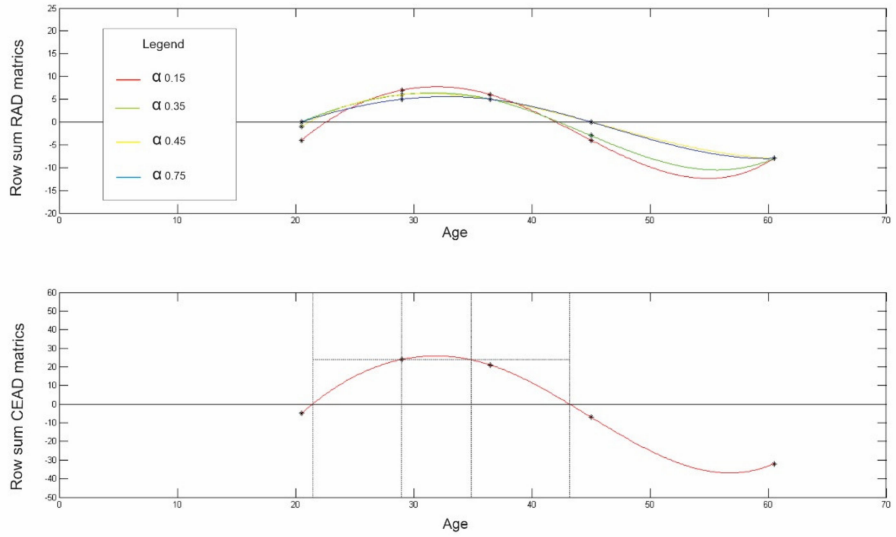

Figure 2. Age influence on social factor using RAD and CEAD matrix.

This distribution is in line with the previous research as, for example, several studies found that social motives are among the most dominant in urban travel. For example, Ref. [89] found that VFR is the principal motive for urban destination visits. Similarly, Ref. [89] argued that going to festivals and events where one not only enjoys the event, but also interacts with other people, is one of the important motives behind travel to urban destinations. Equally, entertainment and nightlife can be seen as involving social motives, and this was presented in the study by [5]. Again, studies on social capital have found that the degree to which people feel connected to others in their community, including tourists, is perceived as a strong predictor of happiness [117].

4.3. Overlapping Different Age Groups with Competence/Mastery Factors

This section analyses the competence/mastery factor and its impact on different age groups regarding the decision-making process within the urban destination visits. The analysed competence/mastery factor includes eight items (Table 1).

Based on Figure 3, it can be concluded that the competence/mastery factor is most dominant between the ages of 34 to 36, when it has the most influence on tourist behaviour. It starts to emerge and affects tourists' decisions at the age of 25, and at the age of 46 it starts to decrease in its influence. These assumptions are confirmed by the CEAD matrix.

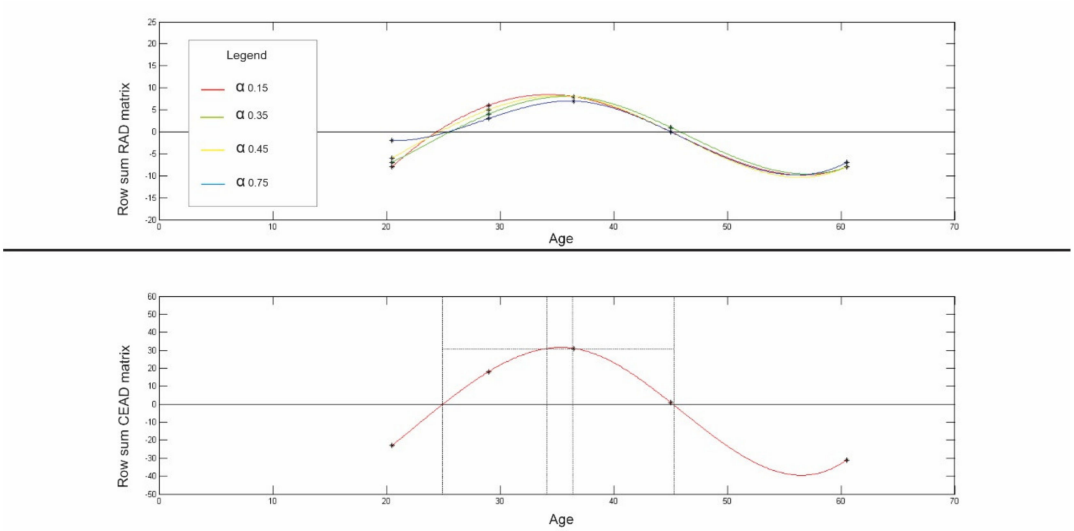

Figure 3. Age influence on competence/mastery factor using RAD and CEAD matrix.

The competence/mastery factor in urban travel can be engaged in several ways, as cities are seen as multi-attraction destinations and as such attract a wide variety of travellers of different social background and travel experiences, further influencing tourist behaviour and motivation. Different pull motives can be identified with the competence/mastery factor, as argued in different studies, such as self-empowerment motives [37], self-actualization [57], learning about natural and cultural heritage [118], and novelty seeking [119].

4.4. Overlapping Different Age Groups with Stimulus/Avoidance Factors

This section analyses the stimulus/avoidance factor and its impact on different age groups regarding the decision-making process within the urban destination visits. The analysed stimulus/avoidance factor includes eight items (Table 1).

Based on Figure 4 we can conclude that the stimulus/avoidance factor is most dominant between the age of 31 to 36, when it has the most influence on travel behaviour. As an affecting factor to tourists' decisions, they emerge at the age of 23 and at the age of 45 it starts to decline and lose its influence. These assumptions are confirmed by CEAD matrix.

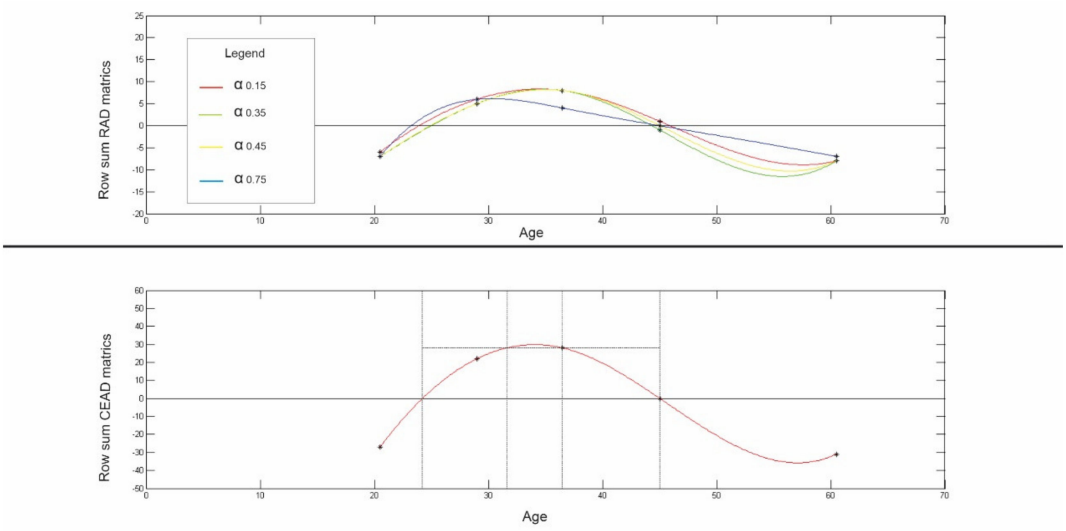

Figure 4. Age influence on competence/mastery factor using RAD and CEAD matrix.

The stimulus/avoidance factor can be connected to stressful lifestyles and, in most cases, would normally be directed towards the other destinations, rather than urban environments [120]. However, some studies have argued for the importance of nightlife and entertainment within tourist cities [91,92,121], which can be linked to stress relief, tension, stimulus and avoidance. This finding is in line with the study by [37] defining pull motives and describing tourists who prefer entertainment, nightlife and shopping in the context of relaxation and having fun at the destination and thus naming them "leisure activities". Furthermore, tourists who prefer festivals and other cultural events, together with local gastronomy, were labelled under motive of "hedonic consumption" [37].

4.5. Discussion of Combined Results

The average age of tourists in the input data for this fuzzy model can shed a light on major internal motivational drivers for visiting multi-attraction destinations. Regarding Novi Sad, the average of tourists in the input data being 37.05 indicates that most tourists are members of Generation Y: people born between 1982 and 2002. In general, this cohort and their motivation are shaped by major events related to technological breakthroughs or social turning points. They are characterised by greater independence, better education, changing roles within the family, and changing family structures [122]. From the behavioural point of view this consumer group is eager to discover and learn about different cultures and interested to interact with local populations [123], which is directly in line with Intellectual and Social factors of Beard and Ragheb's model.

Our results show that the multi-attraction destination of Novi Sad attracts tourists with multi-dimensional motivations. In particular, social factors related to connectedness to other people and the opposite dimension of stimulus avoidance, related to slowing down, are the two with the longest span of influence across tourist ages. As expected, the Intellectual dimension ranked as just lower than the previous two, with a shorter span of influence, and the competence/mastery dimension comes after, with a still shorter span of influence. Our results are in line with other studies of urban tourism showing that the internal motivations of Novi Sad's tourists are mostly related to meeting new people and making new contacts, as well as meeting new cultures [124], since the city is perceived as fun and entertaining [125], which is connected to the social dimension. Previous studies on the image of Novi Sad as perceived by foreign tourists found it to be seen as slow, quiet, peaceful, charming and romantic [126], correlating with our findings on the stimulus/avoidance dimension of the model.

We can further conclude that tourism development based on multi-attractiveness, and tourists who are motivated by different dimensions, can make a contribution to the sustainability of the destination. This will be particularly important in the post-pandemic period where destinations need to further

(re)connect with all market segments, including better defined age groups, aiming to precisely target consumers and to boost the sustainability of their destination and businesses.

5. Conclusions and Contribution

This exploratory research aimed to introduce a fuzzy model as a novel methodology for analysing internal motivations for travel to urban destinations. Most of the previous empirical research on motivation is focused on push and pull theory, but it has rarely considered the complex relationship between tourist motivation and age. The main purpose of this research was two-fold: to introduce a new methodology in tourist motivation research and to apply this newly developed methodology to motivations for travel to urban destinations, which are seeking to attract different-aged tourists to increase their sustainability. Using the fuzzy concept, the levels of influence of four motivation factors were measured for different age groups of tourists. This fuzzy model proved to be a useful tool for approaching tourist motivation research in terms of age and multi-attraction urban destinations. Previous research on age as a component of tourist motivation has most frequently considered it as a way of categorising tourists as a discrete demographic variable. For instance, age has been used to examine the motivations of senior vs. non-senior tourists [63–66], or to examine the motivations of different generations of tourists, defined using very broad age categories [4,69,70,75]. More holistic models have also been applied to tourist motivation, including the TCL [76] and TLC [77], although there is no consensus in the literature about the best way in which to apply these models, or the mechanisms that underlie them. The new fuzzy model provided in this paper (and the associated MATLAB file) can be used by other researchers to generate new data on the dynamic relationship between age and other internal motivation factors, indicated here through the use of Beard and Ragheb's lesiure motivational scale [56], one of the most widely used scales in tourism motivations research [58–62].

This research has focused on a mid-sized European city, Novi Sad, which is typical of many urban tourism destinations in Europe that have approached the problems associated with unsustainable tourism development by emphasising their cultural heritage offer in order to attract older tourists, who DMOs believe will demonstrate more sustainable tourism behaviours during their visit [8,9]. The findings of this research can inform tourism policies and destination management strategies and tactics in Novi Sad, but could also be applied to similar mid-sized cities in Europe with multi-attraction offers, who wish to increase the sustainability of their tourism. For instance, DMOs should take age into consideration when promoting different aspects of their cities as tourist destinations, and this research helps to identify to what extent different motivational factors are affected by the age of tourists. Furthermore, individual tourism businesses can use the findings of this research to help to (re)design their products to enhance their appeal to particular age categories of tourists.

Further contributions and transferability of the method can be found in the fact that the model is useful for other types of destination and not just urban ones, which were the focus within this exploratory study. Furthermore, additional indicators of external motivation or limitations could be examined in relation to age, income or other variables. This would allow easier development, conceptualization, and testing of new motivational models in different environments. One practical contribution can be found in the development of an m-file for MATLAB (provided in the Supplementary Materials for this manuscript) which enables the simple usage and interpretation of results. DMOs, travel agencies, and others can use this tool to tailor-make their offers to the visitors' needs based on the results.

6. Limitations and Future Research Directions

This exploratory study used a fuzzy mathematical model to analyse tourist motivations, in contrast to the more orthodox use of statistical analysis of motivational scales which is more commonly found in tourism research. This approach proved to be useful in this case of multi-attraction urban destination research, where a robust fuzzy methodology allows for the focus on a single factor, or a factor by factor approach. Consequently, the proposed method is less suitable for single attraction destinations, where

more refined and in-depth statistical methods are appropriate to give the in-depth insight needed for tactical decision making.

In order to make the calculus more straightforward and the method more applicable, an original script (m-file) was developed for MATLAB. The applicability of decision-making theory based on such fuzzy measures [127] can be of special interest for further research in tourism. This approach can help with identifying groups with the highest impact on a decision, and, therefore, constructing a fuzzy measure that accurately describes the importance and interactions of all observed groups. Furthermore, integral aggregation tools based on fuzzy measures can be used for obtaining decisions regarding destination management and marketing [128,129]. The advantages of the fuzzy measure-based decision-making process is in the adaptability of fuzzy measures to the decision maker's behaviour, i.e., to tourist motivation. For example, the interaction of different age groups can be modelled by a fuzzy measure and potential mutual "boost" between groups can be emphasised.

One possible direction of the further extension of this research is based on the wider application of fuzzy set theory [130,131]. This extension can now include non-numerical variables. That is, fuzzy sets can be used for modelling non-numerical variables, i.e., linguistic variables. Variables of this form have values given by appropriate membership functions, that is, by fuzzy sets. An adequately chosen defuzzification process can transfer answers of the form "a little", "a lot", "small", "very small", "average", "high", and similar, into numeric values. Furthermore, this approach allows flexible and easier communication with tourists in research, since it is in the human nature to provide descriptive rather than numerical answers. With that in mind, fuzzy models can be applied on a sample based on nationality, income, gender further overlapped with internal motives, external motives or limitations. Finally, this investigation applied the research to the example of an urban destination, a typical multi attraction destination, but it also can be applied to different destination types.

This research opens possibilities for additional research that will provide new synergies between mathematical tools and decision making in the field of tourism. Of special importance is the adaptability of the chosen mathematical tools to human behaviour and the possibility of the additional improvement of these that can be obtained through their application.

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