Data driven stimuli and ontology of cognitive functions in tour planning: A phenomenological study using EFA

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Abstract:
Tour planning is a very interesting domain of study where individuals mentally engage themselves in experiential marketing. Individuals react to the stimuli and in the process participate in the decision-making phenomenon.
Purpose:
The first objective of this study is to investigate the existence of the data driven Stimulus-Organism-Response (S-O-R) phenomenon and analyses the structure of variables simultaneously. The second objective of this study is to examine the role of cognitive domain function score among the tour planners.
Research Method and Methodology:
Primary data was collected by survey method using self-administered questionnaire as tool for collecting data. Non-probability purposive sampling technique was used to collect data. The latent variables considered for this study are attention and cognitive domain function. Both descriptive and inferential statistics have been used for this study. This study was approached with an interdependent quantitative method and multivariate technique of Exploratory Factor Analysis (EFA) was performed.
Findings: Data driven stimuli plays an important role in driving the app user's online navigation behaviour by stimulating the user's cognitive domain functions.

Keywords: Attention, Stimulus-organism-response(S-O-R), Cognitive domain functions

1. INTRODUCTION:

Tour planning is a very interesting domain of study where individuals mentally engage themselves in experiential marketing. Individuals react to the stimuli and in the process participate in the decision-making phenomenon. The penetration of internet and adoption of technologies has completely changed the way an individual search for and consumes information. The necessity of design thinking arises with the human centric problem-solving using Information Communication Technologies (ICT) in the context of tourism. Strategic destination marketing needs to adapt user centric approach to drive growth in tourism industry thereby accelerating new edge transformation in this industry. The rapid change in the individual's critical thinking process with the intervention of ICT necessitates measuring the cognitive domain functions responding to data driven stimuli. The digital transformation penetrating in design thinking encounters challenges of trade-off in innovative marketing practices and tactics for smart, sustainable and inclusive growth. The rapid techno-logical paradigm shifts call for dynamic solutions using user-driven criteria. Critical thinking acts a base for triggering intensions thereby challenging redesigning and implementation of architectural changes in domain areas. (Jamal & Kircher, 2021).

1.1 BACKGROUND:

The necessity and opportunity to learn and acquire knowledge, motor skills and language using ICT interface have brought neuro-cognitive alterations due to neural architectural change in the cortical regions associated with stimuli driven sensory organs.
Emerging bodies of substantial research have empirically investigated cognitive functioning affected by internet and how it is predominantly affecting attention, memory, knowledge and social cognition. The adoption of technology for information consumption and its impact on cognitive functioning is unclear. Some studies have highlighted that it is the brain's malleable capacity of responding to environmental demands and stimuli. The state-of-the-art review for this study tries to understand the gap in the existing literature for investigating the impact of data driven stimuli on cognitive domain function during tour planning among young adults; as the phenomenon is more pronounced among young consumers because of the amount and frequency of usage of mobile web-enabled applications.

1.2 LITERATURE REVIEW:

The consumer behavior models date back to 1940s Input-Output (I-O) model and 1960s (S-O-R) model. These models have depicted the fluid and dynamic process of information flow as a linear, rigid and static phenomenon. Howard and Sheth Model (1969) have conceptualized constructs like attitude and intentions as both internal to organism and as response in some form. Jacob on the contrary have sophisticatedly categorized stimuli into seven sector factors namely- encountered environment, automatic processing, experiential storehouse, consciousness, non-trace Stimulus- response events, internal response and external response.

SENSE AND SENSING: Understanding the response phenomenon:

A vast gamut of past literatures has highlighted the importance of S-O-R phenomenon in consumer's ultimate behavior in environment cues. The causes of changes in consumer behavior depend on the interaction between the quality of stimulus that communicates with the individual. The dimensions of aesthetic and sensory perceptions for purchase intentions are related to stimuli. The organism refers to the attitudinal state which is determined by consumer's internal state of mind. Reactions of consumers in the form of intensions are referred as response.The sensory and motor processing of hand and thumb on smart devices trigger neural changes in the cortical regions of the brain (Gindrat AD, 2015). Along with the S-O-R mechanism, biological and environmental factors also affect the structure and functioning of brain impacting the cognitive domain function. A few evidences indicate virtual activities helps in decision making thereby reducing grey matters in the orbitofrontal cortex.

The domain of marketing uses sensation of sight as a medium to process information. Assessment of neuropsychophysiology of emotions reveals that, visual stimuli exercise more influence on emotional reactivity as compared to auditory stimuli.

DIGITAL DISTRACTIONS: Attention deviation on information highway!

Web atmospheric cues evoke consumers in virtual landscape. Online interactive platforms create a state of flow of information dictated by consumer's navigation behavior in virtual platform. The amount and frequency of mobile web enabled app usage is more prominent among young consumers where they are seen engaging themselves in media multitasking. Evidences from literature advocates media multitasking decreases cognitive capacity and impact functioning at high frequency rates especially among the mobile web enabled app users. Increasing scrutiny of media multitasking highlights that heavy media users performed poor in distracted attention task. (Novak et al., 2000)

BRAIN AND BUYING: The cognitive mechanism behind the brain!

The prefrontal cortex is responsible for executive control in individuals. The cerebrum controls motor skills and processes sensory information thereby responsible for hearing, intelligence and memory. The orbitofrontal cortex (OFC) of the brain lobes is involved in the cognitive process of decision making. The orbitofrontal cortex (OFC) integrates integrate myriads of information regarding the value driven outcome in the form of reward. Prefrontal cortex domain uses value signal to plan and organize behaviour thereby evaluating overall actions in terms of efforts invested by an individual.Cognitive domain functions refer to the mental skill development which includes six major domains in chronological order namely Evaluation, Synthesis, Analysis. Application, Comprehension and Knowledge. Knowledge is the foundational basis of cognitive skills and information retention. Comprehension is something more than just retention, it is classification of items into groups for comparing. In the application domain an individual is allowed to apply the acquired knowledge, skills and abilities in real time situations. In the next domain-analysis, it is about critical thinking and building arguments by distinguishing between facts and opinions and based on these synthesis entails creation or customization in specific situations. And finally, evaluation domain requires higher level skill as it involves assessment and judging the value. (Firth et al., 2019) (Blanco MA, 2014).The first objective of this study is to investigate the existence of the data driven Stimulus-Organism-Response (S-O-R) phenomenon and analyses the structure of variables simultaneously. The second objective of this study is to examine the role of cognitive domain function score among the tour planners.

2. RESEARCH METHOD AND METHODOLOGY:

This study aims to address the research question- Does cognitive domain function score effect the among tour planners? The working hypothesis for the second objective is there is no difference of cognitive domain function score among the non-data driven tour planners and data driven tour planners. This study was approached with an interdependent quantitative approach. Non-probability purposive sampling technique was used to collect data from post graduate students in pan India who had the experience of availing data assisted tour planning experience(s) in last 12 months using smartphone apps. Primary data was collected by survey method using self-administered questionnaire as tool for collecting data. The unit of analysis for this cross-sectional survey is 324. A five-point Likert scale ranging from 1 to 5 was used to measure the items (indicating 1= Never, 2=Rarely, 3= Sometimes, 4= Often and 5= Always). The latent variables considered for this study are attention and cognitive domain function. The items included in the latent variable attention are visual stimuli (vs), auditory stimuli (as) and text stimuli (ts). The items considered for cognitive domain function includes logical, recall, involve, relate, compare and depend. Reverse item was also included in the instrument. The items for cognitive domain functions have been derived from Bloom's taxonomy for learning objectives. The items have been detailed in the below mentioned Table 1.

Table 1: Items considered for the study

Item No.	Item code	Item Name	Latent Variable(s)	Statements
1.	vs	Visual stimuli	Attention	Online visuals (photos/ videos) of tourist destinations draw my attention for planning a trip.
2.	as	Auditory stimuli		I am attentive to online audios relating to trips.
3.	ts	Text stimuli		I pay attention to online text and other online information relating to travel and tourism.
4.	Cdf1	Logical	Cognitive Domain Functions	While using the internet, I always get logically involved.
5.	Cdf2	Recall		I can recall my last online activity
6.	Cdf3	Involve		I involve myself logically in online activities
7.	Cdf4	Relate		I relate myself to other's ideas and thinking
8.	Cdf5	Compare		I compare online information available at different sources
9.	Cdf6	Depend		I am dependent on internet for planning tour related activities
10.	Cdf®	Reverse item		While using the internet, the involvement of my mind is active.

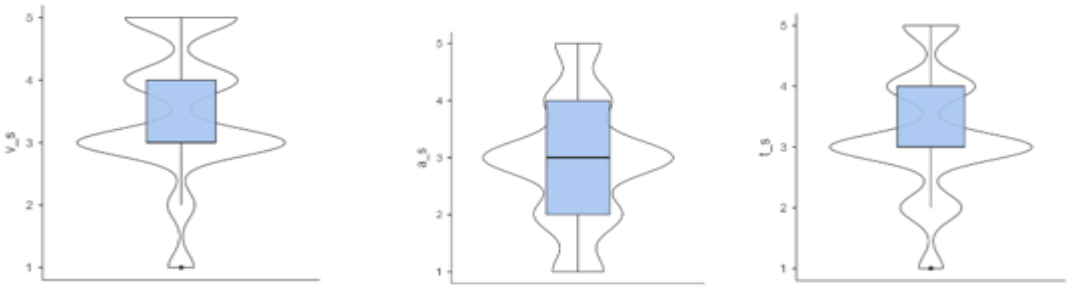
Source: Compiled from the self-administered questionnaire

For analyzing the survey data, both descriptive and inferential statistics have been used for this study. The multivariate technique of Exploratory Factor Analysis (EFA) was performed using jamovi 1.6.9. EFA is used to examine complex multidimensional relationship using factor analytic technique to identify and summarize similar items into smaller set of factors.The reliability test for the items for latent variables - attention and cognitive domain function shows the value of Cronbach alpha 0.690 and 0.719 respectively which signifies its acceptability as per rule of thumb.

3. FINDINGS AND DISCUSSION:

The descriptive statistics for the items of latent variable attention includes Shapiro-Wilk p for visual stimuli (vs), auditory stimuli (as) and text stimuli (ts) which shows $p < 0.001$ indicating data are not normally distributed. The skewness and kurtosis for visual stimuli (vs), auditory stimuli (as) and text stimuli (ts) are -0.305, 0.0861, -0.0131 and -0.209, -0.398 and -0.179 respectively. Visual stimuli (vs) and text stimuli (ts) are negatively skewed whereas auditory stimuli (as) are positively skewed and the negative values for kurtosis implies a flatter distribution ruling out presence of outlier.In the Figure1, the violin box plot for visual stimuli highlights that the density plot for the distribution is thicker in the upper side indicating more frequencies lies in the range from point 3 to point 5 i.e., sometimes to always and the interquartile range lies between point 3 and point 4 i.e., sometimes and often.The probability density function for auditory stimuli is wide in the centre indicating its occurance at point 3 i.e., sometimes and its interquartile range lies between point 2 and point 4 i.e., between rarely and often. The plot for text stimuli shows thickest distribution at point 3 i.e., sometimes, thicker at point 2 and point 4 i.e., rarely and often.

Fig1: Violin box plot for the items of attention



Source: Compiled from the survey data

The descriptive statistics for the items of the latent variable cognitive domain function has been detailed below in Table 2.

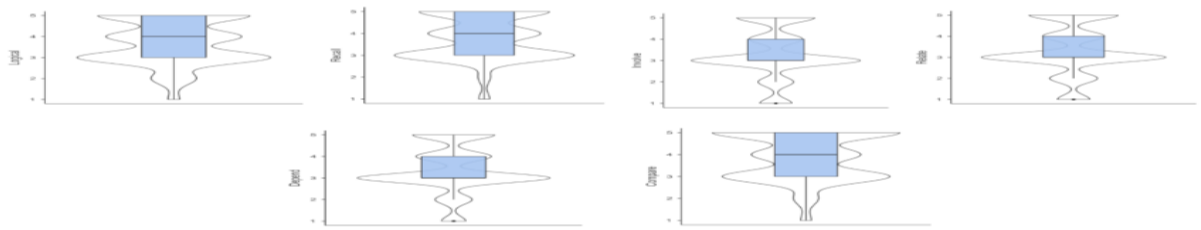
Table 2: Descriptive statistics for the items of latent variable cognitive domain function

	Cdf1	Cdf2	Cdf3	Cdf4	Cdf5	Cdf6	Cdf®
Std. error mean	0.0579	0.0550	0.0648	0.0645	0.0583	0.0603	0.0541
Mode	3.00	3.00	3.00	3.00	5.00	3.00	3.00
Standard deviation	1.04	0.988	1.16	1.16	1.05	1.08	0.970
Variance	1.08	0.975	1.35	1.34	1.09	1.17	0.942
Skewness	-0.271	-0.299	-0.120	-0.0878	-0.473	-0.115	-0.0427
Kurtosis	-0.633	-0.307	-0.500	-0.566	-0.550	-0.321	-0.721
Shapiro-Wilk p	< .001	< .001	< .001	< .001	< .001	< .001	< .001

Source: Compiled from the survey data

The probability distribution function of all the items for the latent variable cognitive domain function has been explained by the violin box plot in the Figure 2. The distribution seems to be wide in the center and above that. The interquartile range for *logical, recall and compare* lies between point 3 to point 5 i.e., between sometimes and always whereas the interquartile range for *involve, relate and depend* lies between point 3 to point 4 i.e., between sometimes and often.

Fig 2: Violin box plot for items of cognitive domain functions



Source: Compiled from the survey data

The latent factors attention and cognitive domain functions have been explored by measuring the set of items through EFA generated coefficients (factor loading) and the correlations between the observed variables that co-vary. The associated error terms explain the variance in the unexplained observed variables. Factor loading > 0.5 have been considered as useful indicator for measuring the latent variable.

The first assumption check for the latent factor has been carried out using Barlett's Test of Sphericity and KMO measure of sampling adequacy. Barlett's Test of Sphericity indicates whether the observed correlation matrix deviates significantly from the null correlation matrix at $p<0.05$ so that Exploratory Factor Analysis can be carried out or not. The result of the Barlett's test for the study given in Table 3 shows a statistically significant p value which is <0.001, hence the assumption has been satisfied.

Table 3: Bartlett's Test of Sphericity

χ^2	df	p
578	45	< .001

Source: Compiled from the dataset

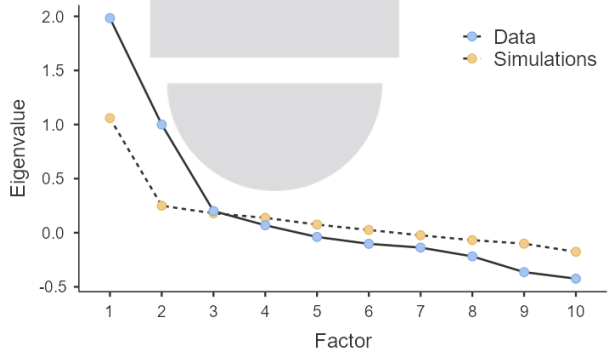
The second assumption check for the latent factor has been carried out using Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy (MSA) which represents the variance proportion among observed variables through partial correlation. EFA is considered to be suitable if the KMO value lies above 0.6. The MSA for the observed items has been detailed in Table 4 which suggest that EFA can be carried out as the assumption has been fulfilled.

Table 4: KMO Measure of Sampling Adequacy

	MSA
Overall	0.741
Visual stimuli	0.797
Auditory stimuli	0.752
Text stimuli	0.738
Logical	0.749
Recall	0.690
Involve	0.704
Relate	0.752
Compare	0.688
Depend	0.801
Reverse item (R)	0.769

Source: Compiled from the survey data

Fig 3: Scree Plot of observed items



Source: Compiled from the survey data

The Scree Plot in Figure 3, the observed items show levelling off after point 3 highlighting a noticeable inflection forming an 'elbow'.

Table 5: Correlation Matrix

	1	2	3
1	—	0.0137	0.0633
2		—	0.1367
3			—

Source: Compiled from the survey data

The varimax approach to rotation has been considered for this study as the substantial correlation between the extracted factors is < 0.3 as detailed in Table 5.

Table 6: Factor Statistics Summary

Factor	SS Loadings	% of Variance	Cumulative %
1	1.68	16.8	16.8
2	1.21	12.1	28.9
3	1.18	11.8	40.6

Source: Compiled from the survey data

The table 6 highlights that the overall proportion of variance in the data accounts for 40.6% by 3 factors. Factor 1 accounts for 16.8% variance and factor 2 and 3 accounts for around 12 % variance. Table 6 depicts the factor loadings greater than 0.3. The pattern of factor loadings for the three observed items representing the latent variable attention falls under Factor 1. The factor loading for the observed reversed item Cdf® for latent variable cognitive domain function falls below 0.3 and hence the value has been hidden in the table. The other observed items representing the latent variable cognitive domain function 'depend' & 'logical' falls under factor 1, 'compare' & 'recall' falls under factor 2 and 'involve' & 'relate' falls under factor 3. Apparently, the positive scores against all the observed items indicates the strong stimuli driven attention and high cognitive domain function in the S-O-R phenomenon.

Table 7: Factor Loadings

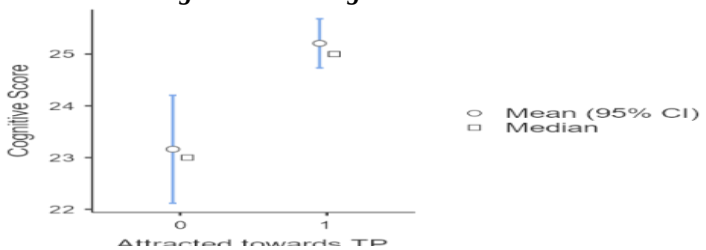
	Factor			
	1	2	3	Uniqueness
Text stimuli	0.695			0.473
Auditory stimuli	0.646			0.581
Visual stimuli	0.581			0.578
Depend	0.458			0.703
Logical	0.445			0.784
Cognitive function (R)				0.966
Compare		0.852		0.224
Recall		0.519		0.693
Involve			0.809	0.295
Relate			0.540	0.638

Note. 'Maximum likelihood' extraction method was used in combination with a 'varimax' rotation
Source: Compiled from the survey data

The uniqueness in Table 7 indicates the proportion of variance not explained by item; greater the uniqueness, lower the impact of that item in factor model. The items compare and involve has relatively low variance, not accounting for factor solution by 22.4 % and 29.5% respectively. On the contrary, 96.6% variance in the reverse item is not explained by the factor model.
From the analysis, factor 1 has been renamed as "Attraction intensity" clubbing the 5 predictors namely text stimuli, auditory stimuli, visual stimuli, depend and logical, factor 2 as "Retrospective comparison" as it accounts for compare and recall and 3rd factor as "Relational extension" corresponding to 2 predictors namely involve and relate.

This study adopted factor-based score approach, to make a comparative analysis of overall cognitive score among the two groups- namely "Data driven tour planners" and "Non-data driven tour planners" represented by 1 and 0 respectively in Figure 4.

Fig 4: Overall Cognitive Mean score



Source: Compiled from the survey data

There is statistically significant difference between the two groups of tour planners. The group of individuals with relatively low cognitive score are less likely to response to the data generated stimuli for destination attraction in reference to pre-tour planning process (Mann-Whitney U = 6325, $p < 0.001$).

4. CONCLUSIONS:

From the analysis and interpretation of this study, it can be concluded that visual stimuli have more impact on user's attention thereby facilitating decision-making process as compared to auditory and text stimuli. Text stimuli on the contrary have the least impact in driving user's attention. Individuals with high cognitive score are more likely to participate in the data assisted tour planning using smartphone apps as compared to individuals with low cognitive score. Data driven stimuli plays an important role in driving the app user's online navigation behaviour by stimulating the user's cognitive domain functions.

REFERENCES

1. Blanco MA, C. C. (2014). *A survey study of evidence based medicine training in US and Canadian medical school*. *J Med Lib Assoc.* , 102(3):160-8.

2. Firth, J., Torous, J., Stubbs, B., Firth, J. A., Steiner, G. Z., Smith, L., Alvarez-jimenez, M., Gleeson, J., Vancampfort, D., & Christopher, J. (2019). *The " online brain ": how the Internet may be changing our cognition*. *June*, 119–129. https://doi.org/10.1002/wps.20638
3. Gindrat AD, C. M. (2015). *Use-dependent cortical processing from fingertips in touchscreen phone users. Curr Biol ; 25*, 109-16.

4. Jamal, T., & Kircher, J. (2021). *Re-Visiting Design Thinking for Learning and Practice : Critical Pedagogy , Conative Empathy*. 1–25.
5. Novak, T. P., Hoffman, D. L., & Yung, Y. F. (2000). *Measuring the customer experience in online environments: A structural modeling approach. Marketing Science*, *19*(1), 22–42. https://doi.org/10.1287/mksc.19.1.22.15184