

Data analysis techniques in observational designs applied to the environment-behaviour relation¹

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Abstract

From the plan about some procedural structures -observational designs- starting from some criteria that constitute the natural axes of the observational studies, we propose in this paper the most appropriate analytical techniques in each case. We consider the adequation of these analytical techniques in function of the criteria that allow us to differentiate between observational designs, and we comment their similarities and differences. The election of each one of these techniques depends on the plan of the study and the kind of data we have collected. Moreover, we propose some illustrations of this observational designs in the field of people-environment relationships.

Key-words: Observational designs, environment-behaviour relation, data analysis techniques.

Introduction

Traditionally, after having delimited the object of study, in the classic times of the observational procedure, a scarcely vertebrate decision making took place that was not due to any previously established plan and was exposed to the actual circumstances, especially in what refers to the data analysis from the data obtained in the record. One of the first decisions made in the present stage of observational methodology -the beginning of which could be dated around 1976 or 1978, years in which important works were released, such as those by Bakeman & Dabbs (1976) or Sackett (1978)- was probably to establish a intersessional and intrasessional perseverance that led to the rejection of any session that did not meet certain requirements established at the beginning according to the considered issue. Another cautious item established in order to

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preserve the procedural strength in the process of observational procedure was the need of having a previous passive or scouting phase that, although worthless at the record level, fulfilled the important tasks of guaranteeing the proper fencing of the problem, allowing the training and formation of the observer, reducing the reactivity bias and, especially, allowing an important information wealth about the situation that would allow a later decision making grounded and motivated in the different moments of the process.

Gradually several procedural measures were introduced in order to preserve the scientific character of the process of observational procedure. To that aspect it is to mention the deep debate about the behaviour unit, the vertebration of the observational taxonomy, the classification of the session rejections, the introduction of session microanalysis, the creation of new observation instruments, the new codification forms according to the technological progress, the classification and use of record parameters, the structuration of observational sampling, the important development of the data quality control or the progressive proposal of analytical techniques. All this procedural contributions help to outline the two sides of the coin: the observational methodology is very flexible, and yet very strict.

The procedural structures in observational designs focuses on the spontaneous behaviour of an individual, requiring the maximum display of *naturality* in the context where the study is taking place. Unlike the rest of design structures, and given the unforeseeable response in the human behaviour and the concurrence of multiple conducts and, simultaneously, multiple response levels, this implies a creation of *ad hoc* instruments. Compared to an experimental design, there is probably no difference in the immediate objectives of the study, but the possibility of studying environment-behaviour relationships in the observational designs is restricted to almost nothing because the design features of a research – *randomness, manipulation and control*- in the peculiar and particular context where the research takes place are extremely limited.

We are not pretending that the structure of observational design can substitute other techniques and research procedures, but it could have been applied to many particular studies and, probably because it is not an easy option, other inappropriate procedural methodologies have been applied. The sampling filter in the direct observation allows a continuous

record of the behaviour as well as its later processing from the probabilistic and estocastic point of view. However, we have to keep in mind that this kind of procedure implies important economic and material costs (high budgets and infrastructure) as well as sophisticate technology in order to keep a reliable record. Nowadays the studies held in natural contexts can be based on a procedural, technical and scientific structure, brought up thanks to the observational designs, that can stand alongside with other methodologies that have reached very high standards in the scientific production of Psychology. The choice of the most appropriate design and procedure is another question, but when the observation is suitable to the pretended study, the procedural structure proposed can be as powerful as any other, moreover when we count on statistical evidence about the needed efficacy to this purpose.

Observational studies environment-behaviour: Basic designs

In the observational studies in general and, of course, in those related to any aspect of the relationship environment-behaviour it is necessary to have a conceptual structure that is the outline or framework on which depends all the process to follow. In the same way as the complexity of the record determines the size of a codification system without lowering the ratio cost-benefit (Blanco, 1997), the magnitude of the objectives should also determine the basic structure and features of the design while maintaining an optimal cost-benefit ratio. Therefore, the decision about the appropriate design is previous to any procedural operation related to how to recognize, organize and analyse the data and, obviously, underlies the determination of the study objectives (Anguera, Blanco & Losada, 2001a).

In previous works (Anguera, 1985, 1995, 1999; Anguera, Blanco and Losada, 1995; Losada, 1999) we presented initial proposals about the method of observational designs, that have allowed us to test repeatedly and in different applications, the multiple possibilities in the wide casuistry of situations generally present in studies based on the environment-behaviour relationship; its integration has recently been published in a single proposal (Anguera, Blanco and Losada, 2001b).

The main criteria as reference axes are the following:

1. *Record temporality*. The basic configuration in the observational designs is structured around this criterion, that

allows to distinguish among a punctual record and a follow-up record. The punctual record allows an analysis of the relationship environment-behaviour in a given moment in the time (generally on one single observation session) while the follow-up implies having held a number of sessions in a long time period of data collection, that are organized intersessionally according to the approach of the observational sampling.

2. *Observed items*. These can be 1 or n, depending on the observed subjects. We name them idiographic and nomotetic. This is a basic criterion that not always has the same relevance but presents important questions in the methodological aspect, depending on the subjects being considered individually or as members of a collective group (or a representative part of it). It is important to point out that a small group of subjects acting as a unit is considered idiographic, extending the classic sense of this word.
3. *Response level*. The third criterion refers to the response level or dimensionality, that sets the so-called unidimensional or multidimensional studies. The behaviours that can be observed in one or various subjects can be diverse and this wide casuistry needs a logical structure that can systematize them in different response levels through an appropriate taxonomy, among all the existing ones.

The combination of these three mentioned criteria generate a range of possibilities that allows to exhaust all the existing casuistry, allowing the delimitation of the different observational designs; in each case from them it will lead a contour of the process profile according to the features of the design, that has now a principal role in the approach and development of the possible situations. The crossing of the three mentioned criteria allows the creation of the following eight observational designs (Anguera, Blanco y Losada, 2001b):

1. Punctual design / Idiographic / Unidimensional (P/I/U)
2. Punctual design / Idiographic / Multidimensional (P/I/M)
3. Punctual design / Nomotetic / Unidimensional (P/N/U)
4. Punctual design / Nomotetic / Multidimensional (P/N/M)
5. Follow-up design / Idiographic / Unidimensional (F/I/M)

6. Follow-up design / Idiographic / Multidimensional (F/I/M)
7. Follow-up design/ Nomotetic / Unidimensional (F/N/U)
8. Follow-up design / Nomotetic / Multidimensional (F/N/M)

In the Environmental Psychology a wide casuistry of environmental-behaviour relationships is to be observed and all of them fit into this taxonomy of the designs, graphically represented in Figure 1.

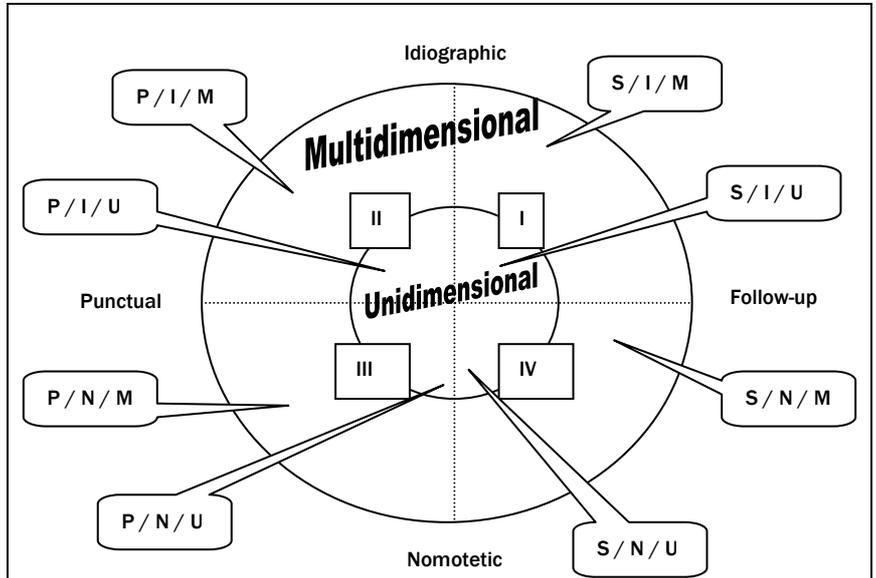


Figure 1. Graphic representation of the limiting criteria in the observational designs.

Any approach is to be found in one of these eight structures. When the delimitation of the object of study and the assessment of the available resources (especially human and temporal) lead to the choice of one design as the most appropriate one, a series of decisions deploys that are related to crucial aspects of the study and, especially, to the observation instrument that is to be build (category system, field formats, combination of them or rating scales), primary record parameters (according to occurrence, order or duration), type of data needed to get and possible transformations among them, record rules (how is the behaviour to be recorded?) and sampling (which subjects are to be observed and when?), the organization intersessional and intrasessional of the observation

sessions, the record measures that are to be used (primary, mixed or secondary), the best way of making a data quality control in the corresponding intra-observer approach or among observers, and data analysis.

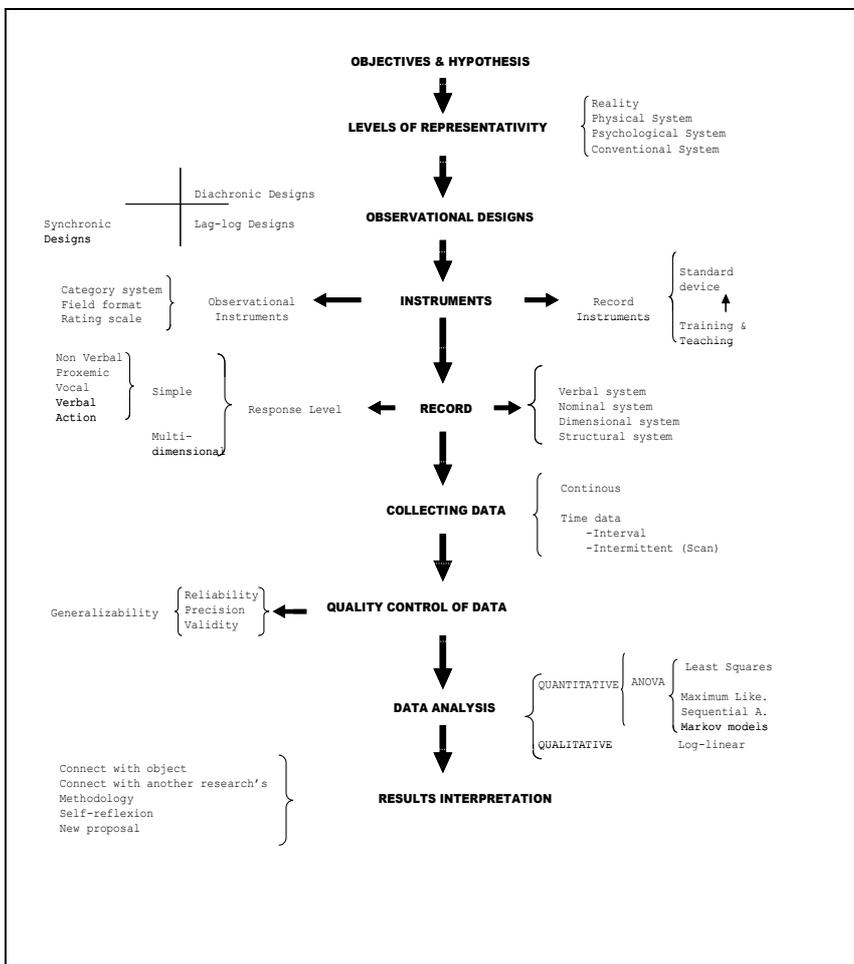


Figure 2. Diagram of the process to follow in an observational environment-behaviour study (Anguera, Blanco y Losada, 2001a).

One of the most important decisions that are led from the observational designs is precisely the one referred to the data analysis

method that better suits in each case. When reviewing the scientific literature about observable environment-behaviour relations in the last decade (Anguera, 1994) from the bibliometric point of view, its variability is evident; however it is evident as well that there we can detect certain trends or usages that are highly incident in analytical techniques compared to the incidental usage of other ones.

Analytical techniques in the observational designs set out for the study of the relation environment-behaviour

Anguera, Blanco and Losada (2001b) show a list of feasible analytical techniques to be used according to the corresponding observational design, obviously without affecting the compliance of the restrictions and requirements of each of them in every case. From this listing in the present work we are discussing the extent of efficacy of particular analytical techniques in different designs, or the way in that certain techniques are specific, that can only be linked to some specific design. Furthermore we will define in an illustrative way each of the quadrants in the field of the observable relation environment-behaviour.

The descriptive statistics, ordinal correlation, chi-square and the first order Markov chains can be applied in all the designs, all of them being analysis techniques of non specific data for observational research. Among these, to which we will specifically address, there are only two analytical techniques -intrasessional sequential analysis and analysis of polar coordinates-, that can be applied in the eight designs. The reason for the first of them lies in that in all designs there is at least a session setup (P/I/U; P/I/M; P/N/U and P/N/M) or many (S/I/U, S/I/M; S/N/U and S/N/M) from which we can obtain the appropriate record (through an instrument of the categories system, field format or a combination of both) thanks to primary measures of order or duration, following some rules of continuous record and getting data of the kind I or III (or kind II or IV and transforming them afterwards) and controlling the data quality through some of the different existing coefficients (Blanco, 1989, 1991, 1992 and 1993) and we try to find the stable sequential relations among the different recorded behaviours. The second of these techniques that can be applied to all designs, the analysis in polar coordinates, aims to create a map with all possible interrelations among all categories or codes of field format registered through a vectorial representation that

allows to recognize the nature of each of those relations (through the angle) as well as its intensity (through the vector length).

The rest of analytical techniques suitable to the different designs are not to be used in a generic way, but depending on the concrete features of every possible grouping that can be created with these designs; here we will use the criterion of dimensionality or response level. According to the quadrants defined in Figure 1, we distinguish the designs according to the criteria that define them and their position in the graphic representation (note that the quadrants are numbered in the opposite direction of a clock):

Quadrant I: Follow-up / Idiographic / Unidimensional (S/I/U) Design and Follow-up / Idiographic / Multidimensional Design (S/I/M)

The Quadrant I is characterized by the follow-up of a subject or a context throughout a certain time, after registering a certain number of sessions. There is also the possibility of being interested in only one response level (S/I/U) or many of them (S/I/M).

In the first case, the studies would be restricted to unidimensional responses, as could be the case when observing a proxemic or verbal behaviour. There are many empirical scientific studies that would fit into this design, since in many observable relations environment-behaviour it is possible to characterize the follow-up of certain behaviours or episodes that take place in a context throughout a certain period of time. In the Quadrant I, the intra-class correlation, the temporal series, the analysis of variance and the analysis of variance for categorical data would be typical for these designs. Illustrative of this kind of design are the works of Izquierdo (1993), Ardá (1998) or Anguera and Losada (1999), among many others.

In the second case, the complexity of the answer is higher, since it includes the different levels of response are complementary, as phenomena of human communication or different transmissions. In general, the studies show wider objectives, or, at least, the response shown is bigger. For example, discussions held throughout a long period of time where the level of verbal response and another one of vocal, verbal or proxemic nature would be recorded. In this design we consider as specific the multiple correlation, the multiple temporal series, the multiple analysis of variance, the multidimensional scaling and the non-

parametric tests. In this design the studies of Garaigordóbil, Maganto y Etxeberría (1996) or Ordóñez (1999), among others, are to be found.

At the same time, to both designs would be appropriate the intersessional and sequential analysis, the logistic regression (considering that the level of response would be dicotomic or dicotomizable), the panel analysis and the trend analysis.

Quadrant II: Punctual / Idiographic / Unidimensional (P/I/U) Design and Punctual / Idiographic / Multidimensional (P/I/M) Design

In the quadrant II we include the situations where the punctuality of the record increases its weakness. During some decades, the studies in this quadrant have not had scientific entity, but a pre-scientific one, and they were seen as mere exploratory studies due to their inherent weakness that is to imply from its punctual character, that is usually limited to a one unique session of observation and record of an observation unit.

In the framework of the relations environment-behaviour they are an uncommon approach, except for the exploratory studies, and we distinguish between considering one single response level (P/I/U) or a combination of different ones (P/I/M). The idiographic feature of the context does not usually refer to a unique subject, but a group of them, whenever they build a unity.

In the first case there are no own analytical techniques and only the generic ones considered for all the designs are to be regarded as possible.

On the other hand, in the P/I/M design it is possible to use the log-linear analysis, the intra-class correlation, the logistic regression and the non-parametric tests. The work of Busch (2001) follows this design for all of the shopping centres where the study has been applied.

Table 1. Analytical techniques corresponding to the observational designs [From Anguera, Blanco y Losada (2001, p. 154-155)].

Punctual/Idiographic/Unidimensional		Punctual/Idiographic/Multidimensional	
<ul style="list-style-type: none"> • Descriptive statistics • Ordinal correlation • Chi-square • First order Markov chains 	<ul style="list-style-type: none"> • Intrasessional and sequential analysis • Analysis of polar coordinates 	<ul style="list-style-type: none"> • Descriptive statistics • Ordinal correlation • Chi-square • First order Markov chains • Intrasessional and sequential analysis 	<ul style="list-style-type: none"> • Analysis of polar coordinates • Log-linear analysis • Intra-class correlation • Logistic regression • Non-parametric tests
Punctual/Nomotetic/Unidimensional		Punctual/Nomotetic/Multidimensional	
<ul style="list-style-type: none"> • Descriptive statistics • Ordinal correlation • Linear correlation • Chi-square • First order Markov chains 	<ul style="list-style-type: none"> • Intrasessional and sequential analysis • Analysis of polar coordinates • Non-parametric tests 	<ul style="list-style-type: none"> • Descriptive statistics • Ordinal correlation • Linear correlation • Chi-square • First order Markov chains • Intrasessional and sequential analysis 	<ul style="list-style-type: none"> • Analysis of polar coordinates • Intra-class correlation • Logistic regression • Non-parametric tests
Follow-up/Idiographic/Unidimensional		Follow-up /Idiographic/Multidimensional	
<ul style="list-style-type: none"> • Descriptive statistics • Ordinal correlation • Chi-square • First order Markov chains • Intrasessional and sequential analysis • Interssional and sequential analysis • Analysis of polar coordinates 	<ul style="list-style-type: none"> • Intra-class correlation • Logistic regression • Panel analysis • Trend analysis • Temporal series • Analysis of variance • Analysis of variance for categorical data 	<ul style="list-style-type: none"> • Descriptive statistics • Ordinal correlation • Chi-square • First order Markov chains • Intrasessional and sequential analysis • Interssional and sequential analysis • Analysis of polar coordinates 	<ul style="list-style-type: none"> • Multiple correlation • Logistic regression • Panel analysis • Trend analysis • Multiple temporal series • Multiple analysis of variance • Multidimensional scaling • Non-parametric tests
Follow-up/Nomotetic/Unidimensional		Follow-up /Nomotetic/Multidimensional	
<ul style="list-style-type: none"> • Descriptive statistics • Ordinal correlation • Chi-square • First order Markov chains • Intrasessional and sequential analysis • Interssional and sequential analysis • Analysis of polar coordinates 	<ul style="list-style-type: none"> • Intra-class correlation • Logistic regression • Panel analysis • Trend analysis • Temporal series • Multiple temporal series • Analysis of variance • Analysis of variance for categorical data 	<ul style="list-style-type: none"> • Descriptive statistics • Ordinal correlation • Chi-square • First order Markov chains • Intrasessional and sequential analysis • Interssional and sequential analysis • Analysis of polar coordinates 	<ul style="list-style-type: none"> • Multiple correlation • Logistic regression • Panel analysis • Trend analysis • Temporal series • Multiple temporal series • Multivariate analysis of variance • Multidimensional scaling

Table 2. Analytical techniques corresponding to the designs placed in Quadrant II.

Criterion of temporality	Criterion of observed subjects	Criterion of response levels	Observational design	Analytical techniques
		Unidimensional	P / I / U	<ul style="list-style-type: none"> •Descriptive Statistics •Ordinal correlation •Chi-square •First order Markov chains •Intrasessional and sequential analysis •Analysis of polar coordinates
Punctual	Idiographic	Multidimensional	P / I / M	<ul style="list-style-type: none"> •Descriptive Statistics •Ordinal correlation •Chi-square •First order Markov chains •Intrasessional and sequential analysis •Analysis of polar coordinates •Log-lineal analysis •Intra-class correlation •Logistic regression •Non-parametric tests

Quadrant III: Punctual / Nomotetic / Unidimensional (P/N/U) Design and Punctual / Nomotetic / Multidimensional (P/N/M) Design

In this Quadrant III there are the studies that, while keeping a weakness in the cross section in the temporal dimension, extend themselves in an extensive way since they have no limit in the quantity of units observed. Generally these are studies where the context itself is in the focus of the study and where different levels are deployed, while the relations existing among them are analysed, or in investigations aimed to know the structure of the exchange network established among their members.

Both designs share, as specific analytical techniques, the lineal correlation and the non parametrical tests as well as the generic ones mentioned before.

The design P/N/U does not foresee the possibility of new techniques in data analysis, whereas the P/N/M admits, as well, the log-linear analysis, the intra-class correlation and the logistic regression (always when the behaviour to study is dicotomic or is dicotomized).

To the first of these designs belong the researches by Castellano (2000) and Máiquez, Blanco and Capote (2000). And to the second belong the works by De Paúl (1990) or the one by Canal and Rivière (1999).

Table 3. Analytical techniques corresponding to the designs placed in Quadrant III.

Criterion of temporality	Criterion of observed subjects	Criterion of response levels	Observational design	Analytical techniques
		Unidimensional	P / N / U	<ul style="list-style-type: none"> • Descriptive Statistics • Ordinal correlation • Linear correlation • Chi-square • First order Markov chains • Intrasessional and sequential analysis • Analysis of polar coordinates • Non-parametric tests
Punctual	Nomotetic	Multidimensional	P / N / M	<ul style="list-style-type: none"> • Descriptive Statistics • Ordinal correlation • Linear correlation • Chi-square • First order Markov chains • Intrasessional and sequential analysis • Analysis of polar coordinates • Intra-class correlation • Logistic regression • Non-parametric tests

Quadrant IV: Follow-up / Nomotetic / Unidimensional (S/N/U) Design and Follow-up / Nomotetic / Multidimensional (S/N/M) Design

The quadrant IV includes the designs with the most wealth of information, together with a higher complexity. On the one hand, the temporal follow-up allows the introduction of an interesting aspect in the

study and, on the other, the fact of being nomotetic allows to work in different contexts, being one or some subjects in each one of them.

Table 4. Analytical techniques corresponding to the designs placed in Quadrant IV.

Criterion of temporality	Criterion of observed subjects	Criterion of response levels	Observational design	Analytical techniques
		Unidimensional	S / N / U	<ul style="list-style-type: none"> • Descriptive Statistics • Ordinal correlation • Chi-square • First order Markov chains • Intrasessional and sequential analysis • Intersessional and sequential analysis • Analysis of polar coordinates • Intra-class correlation • Logistic regression • Panel analysis • Trend analysis • Temporal series • Multiple temporal series • Analysis of variance • Analysis of variance for categorical data • Non-parametric tests
Follow-up	Nomotetic	Multidimensional	S / N / M	<ul style="list-style-type: none"> • Descriptive Statistics • Ordinal correlation • Chi-square • First order Markov chains • Intrasessional and sequential analysis • Intersessional and sequential analysis • Analysis of polar coordinates • Log-lineal analysis • Multiple correlation • Logistic regression • Panel analysis • Trend analysis • Temporal series • Multiple temporal series • Multiple analysis of variance • Multidimensional scaling • Non-parametric tests

As specific analytical techniques, both designs share the intersessional and sequential analysis, the logistic regression, the panel analysis, the trend analysis, the temporal series, the multiple temporal series and the non-parametric tests.

The first of the mentioned designs (S/N/U) admits as well the possibility of using the analysis of variance and the analysis of variance for categorical data. This is illustrated by the designs by Tójar (1996) and Pastor y Sastre (1999).

The second design (S/N/M) considers the possibility of a multivariable analysis of variance and the multidimensional scaling, as specific techniques of data analysis. Among the empiric studies that fit into this design we can name Cerezo & Pons (1996), Hernández Mendo y Anguera (1998) and Riberas y Losada (2000).

Conclusions

The study of the relation environment-behaviour has experienced a considerable progress thanks to structural references such as the corresponding observational designs, that work as a framework or guide to which obey the different methodological operations that build the process to follow, being at the same time an important support for the successive decision making that must be done, especially in what refers to the most appropriate analytical technique(s).

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