RATIONAL CHOICE AND REVEALED PREFERENCE

Raman Kumar Agrawalla*

It is the increasing disenchantment with the subjective overtones of the traditional utility theory that fetched out a path-breaking approach entitled "Revealed Preference" to the forefront of the theory of consumer behaviour. But the revealed preference theory is found to be almost exclusively obsessed with the "transitive" requirement of preferences of consumers, specifically of the "competitive consumer". Since the magnum opus of Arrow, efforts are on to free the revealed preference approach from the fetters of "restricted domain" so that choice other than that of pure consumption could be studied and analysed effectively. It is this theory of choice, in fact, rational choice on "unrestricted domain" that helps changing the structure of revealed preference theory from its prototype format for the finer and fuller exposition. The main objective of this paper is to undertake a survey of some important papers in this area.

I. INTRODUCTION

'Choice' coupled with the problem of scarcity is of paramount importance for human life. Anything important cannot be decided at random or let to one's whim. It has, therefore, been the effort of Social Sciences in general and Economics in particular to bestow the concept of choice with some "rational" underpinnings. Ordinarily, "choice being rational" means the selection of those alternatives from a host of available alternatives that lands the choice making agent on the 'best attainable position'. In other words, the concept of rational choice, found rampant in the traditional literature of rational choice behaviour, is that the choice of a rational agent besides being "purposive", his or her preference relation has to satisfy "the logical requirement of transitivity". In technical jargon, Arrow, a pioneer in the field of rational choice, writes that economists have traditionally identified the concept of rationality with the notion of choices derivable from an 'ordering'. Considering the transitive requirement of rational behaviour as something very strong, there is a plethora of papers that have weakened the traditional conception of rational choice. All these exercises discuss rational choice vis-a-vis optimisation of some preference relation irrespective of whether or not this is transitive. The objective of the present paper is to undertake a review of the literature in this field. As Suzumura (1983) points out, "The notion of rational choice as optimising choice goes at least as far back as Robbins (1935), and it has been extensively studied in recent years, most notably by Arrow (1959), Richter (1966, 1971), Wilson (1970), Sen (1971), Plott (1973), Herzberger (1973), Schwartz (1972, 1976), Blair & associates (1976), and Suzumura (1976)". However, this paper mainly takes into account the works of Arrow (1959), Richter (1966;

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* Lecturer in Economics, Department of Commerce, Shri Ram College of Commerce, University of Delhi, Delhi.
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1971), Sen (1971; 1977; 1982; 1986) and Suzumura (1976; 1983). Another pertinent point worthy of mention is that in this paper we retain the spirit of traditional micro economic theory which considers "rationality" as an attribute of an individual's preference though in the post-Arrowian literature on choice theory individual preferences are treated as unobservable.

In Section II, we enumerate all the notations and definitions used in this paper. Section III discusses the rationalizability problem under unrestricted domain, a case where the domain of the choice function consists of all finite non-empty subsets of the universal set. In Section IV, we discuss the rationale of unrestricted domain and its implications vis-a-vis implications of restricted domain for rationality. And in Section V, we make some comments based on this review and conclude with a brief critical note relating to inadequate structure of economic theory to take care of all aspects of human behaviour.

II. NOTATIONS AND DEFINITIONS

The following notations will be used throughout :

$\exists$	existential quantifier ("there exists")
$\forall$	universal quantifier ("for all")
$\rightarrow$	implication ("if ....., then ....")
$\leftrightarrow$	equivalence ("if and only if") = ("iff")
~	negation ("not")
&	conjuction ("and")
=	identity
$\Rightarrow$	this follows that
$x \in A$	x belongs to A
$x \notin A$	x does not belong to A
$A \subseteq B$	A is a subset of B
$A \subset B$	A is a proper subset of B
$A \cap B$	intersection of A and B
$A \cup B$	union of A and B
φ	empty set (set having no element)

Let X be the universal set, the set of all conceivable alternatives like x, y, z, etc.; χ be the set of all subsets of X excluding the null set φ and A, B, S, be some available sets. Let R referring to 'at least as good as' be a binary weak preference relation (bwpr) defined over X. Therefore, $R \subseteq X^2$, i.e., R is any subset of cartesian product of X with itself (set of ordered pairs) and xRy is taken to mean that the choice making agent considers x to be at least as good as y. Given R, we can define the strong or strict preference relation P (the asymmetric part of R) and the indifference relation I (the symmetric part of R).

Definition 1

$\forall x, y \in X$ xPy iff [xPy & ~yPx] and xIy iff [xRy & yRx]

We, now, enumerate several properties of R, required subsequently.

Definition 2

(i) Reflexivity : $\forall x \in X$, xRx

(ii) Completeness : $\forall$ x, $y \in X$ and $x \neq y$, either xRy or yRx or both. This is the same thing as saying that either xPy or yPx or xIy

(iii) Transitivity : $\forall$ x, y, $z \in X$ (xRy & yRz) $\rightarrow$ xRz

(iv) Quasi transitivity : $\forall$ x, y, $z \in X$ (xPy & yPz) $\rightarrow$ xPz

(v) Triple acyclicity : $\forall$ x, y, z$\in$X (xPy & yPz) $\rightarrow$ ~zPx

(vi) Acyclicity : $\forall x_1, x_2, \ldots\ldots\ldots, xn \in X, (x_1 Px_2 \,\&\, x_2 Px_3 \,\&\, \ldots\ldots\ldots x_{n-1} Px_n) \rightarrow \sim x_n Px_1$

(vii) Total : R satisfies (i) and (ii)

(viii) Ordering : R satisfies (i), (ii) and (iii)

Definition 3

(i) Greatest-Point set :

$G(A, R) = \{x \in A / xRy, \forall y \in A\}$

(ii) Maximal-Point Set :

$M(A, R) = \{x \in A / \sim(yPx) \quad \forall y \in A\}$

Definition 4

A choice function is a function

C : $\chi \rightarrow \chi$ such that

$\forall A \in \chi, C(A) \subseteq (A) \,\&\, C(A) \neq \varphi$

Definition 5

(i) Revealed Preference Relation (R_c) :

$\forall$ x, y$\in$X xRcy iff for some A$\in\chi$ x$\in$C(A) & y$\in$A

(ii) Strict Revealed Preference

Relation ($\tilde{P}c$)

$\forall$x, y$\in$x, x$\tilde{P}$c y iff $\exists$ A$\in\chi$ such that

x$\in$C(A) & y$\in$ [A-C(A)]

(iii) Given $\tilde{P}$c, we define $\tilde{R}$c and $\tilde{I}$c :

x$\tilde{R}$c y iff ~ (y$\tilde{P}$c x)

and x$\tilde{I}$c y iff x$\tilde{R}$c y & y$\tilde{R}$cx

Definition 6

Transitive closure of a binary relation T, denoted by T*, is defined as follows :

$\forall$ x, y$\in$X, xT*y holds iff $\exists$ a sequence $x_1, x_2, \ldots\ldots, xn \in X$ such that

$x_1Tx_2 \,\&\, x_2Tx_3 \,\&\, \ldots\ldots\ldots x_{n-1} Tx_n$ with x_1 = x and x_n = y

Definition 7

Base Relation (Rc) :

$\forall$ x, y$\in$X, (x Rcy) iff x$\in$C ({x,y})

Definition 8

Revealed Preference Axioms :

(i) Weak Axiom of Revealed Preference (WARP) :

$\forall$ x, y$\in$X, x$\tilde{P}$cy $\rightarrow$ ~ yR_cx

(ii) Strong Axiom of Revealed Preference (SARP) :

$\forall$ x, y$\in$X, x$\tilde{P}$c* y $\rightarrow$ ~ yR_cx

Definition 9

Congruence Axioms :

(i) Strong Congruence Axiom (SCA) :

$\forall$ x, y$\in$X and $\forall$A$\in\chi$ if [x$\in$C(A) & y$\in$A & . ıcx'] then y$\in$C(A)

(ii) Weak Congruence Axiom (WCA) :

$\forall$ x, y$\in$X and $\forall$A$\in\chi$ if [x$\in$C(A) & y$\in$A & yRcx] then y$\in$C(A)

Definition 10

Rationalizability of a choice function :

A choice function C is said to be rationalizable iff $\exists$ a bωpr R such that C(A) = G(A,R) $\forall$A$\in\chi$

Definition 11

Several degrees of rationality :

(i) Transitive Rationality (TR) :

A choice function satisfies TR iff it can be rationalized by a bωpr $R \in R_T$ where R_T refers to a set of preference relations satisfying ordering.

(ii) Quasi Transitive Rationality (QTR) :

A choice function satisfies QTR iff it can be rationalized by a bωpr $R \in R_Q$ where R_Q is a set of preference relations satisfying totality & quasi transitivity.

(iii) Acyclic Rationality (AR) :

A choice function satisfies AR iff it can be rationalized by a bωpr $R \in R_A$ where R_A is a class of preference relations satisfying totality & acyclicity

Definition 12

Binariness or Normality of a choice function:

A choice function is binary or normal iff $\forall A \in \chi$ $C(A) = G(A,R_c)$

Definition 13

Basic Binariness of a choice function :

A choice function is basic binary iff $\forall A \in \chi$ $C(A) = G(A, R_c)$

Definition 14

Arrow Consistency Condition (ACC) :

$\forall$ A, B $\in \chi$ if $[A \subseteq B$ & $C(B) \cap A \neq \varphi]$ then $C(A) = C(B) \cap A$

Definition 15

Property α :

$\forall$ A, B $\in \chi$ if $[A \subseteq B$ & $C(B) \cap A \neq \varphi]$ then $C(B) \cap A \subseteq C(A)$

Definition 16

Property B^+ :

$\forall$ A, B $\in \chi$ if $[A \subseteq B$ & $C(B) \cap A \neq \varphi]$ then $C(A) \subseteq C(B) \cap A$

Definition 17

Property β :

$\forall$ A, B, $\in \chi$ if $[A \subseteq B$ & $C(B) \cap C(A) \neq \varphi]$ then $C(A) \subseteq C(B)$

Definition 18

Property ε :

$\forall$ A, B $\in \chi$ of $A \subseteq B$ then $C(B) \not\subseteq C(A)$

Definition 19

Property δ :

$\forall$ A, B $\in \chi$ if $A \subseteq B$ then $\forall$ x, y $\in$ A & x $\neq$ y $[x, y \in C(A) \rightarrow C(B) \neq \{x\}$ & $C(B) \neq \{y\}]$

Definition 20

Property γ :

$\forall A^j \in \chi$ j = 1, 2, ..., n

if $x \in C(A^j)$ $\forall$ j = 1, 2, ..., n

$$\text{then } x \in C\left[\bigcup_{j=1}^{n} A^j\right]$$

III. RATIONALITY UNDER UNRESTRICTED DOMAIN

The primitive in the present framework is the choice function, i.e. a mapping which gives information as to what an agent chooses from alternative available sets. The purpose is to discuss the rationalizability problem (the choice functional counterpart of the integrability problem in consumption theory) which is of fundamental importance for the theory of choice. This talks of the concept of rational choice functions and their characterisation in terms of the revealed preference and congruence axioms and consistency conditions. In order to make the choice function well-behaved we either impose certain restrictions on the underlying preference relation of the choice making agents or impose certain consistency conditions on choice sets.

The choice behaviour of an agent is considered to be rational if there exists a preference relation R such that, for every set A of available states, the choice therefrom is the set of "R-optimal" points in A. The optimality concept can be interpreted in two alternative ways, viz., R-greatestness (=R-best) and R-maximality. We do not consider R-maximal viewpoint of optimality since its main relevance is with respect to the concept of pareto efficiency in the theory of resource allocation processes. Moreover, we have the following results.

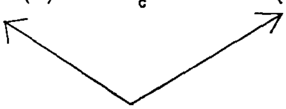
(i) $\forall A \subseteq X \; G(A, R) \subseteq M(A, R)$

(ii) if R is total then $\forall A \subseteq X \; G(A, R) = M(A, R)$

We, therefore, concentrate on the R-best rationality concept.

The following illustration provides clearly an intuitive explanation of the concept of "rationality" in the theory of rational choice.

$C(A) \rightarrow R_c = R \rightarrow G(A, R)$



Starting with the choice function C, we derive the revealed preference relation Rc. If this Rc happens to coincide with the genuine preference relation R, we say that the choice behaviour is rational. This follows from the Theorem 1, mentioned in this section. (All the theorems used are listed at the end of this section).

Arrow (1959) has proved the complete equivalence of the WARP with the existence of an ordering from which the choice function can be derived. The Theorems 2 and 3 reflect this. That is :

TR $\leftrightarrow$ C satisfying ACC (Theorem 2) and

TR $\leftrightarrow$ C satisfying WARP (since WARP $\leftrightarrow$ ACC, Theorem 3)

Thus, the linkage between choice functions satisfying consistency conditions and rationality requirements is established. This result of "ordering rationalization" corresponds precisely to the traditional concept of rational choice. However, we have already defined several degrees of rationality among which TR, the strongest one, got subsequently weakened to QTR and AR. It is to be noted that Sen (1982; 1986) has weakened β^+ property to some other properties, given by the following two results (i) and (ii) and subsequently proved the linkage with respect to weaker conditions of QTR and AR, shown by the Theorems 4 and 5.

(i) $\beta^+ \rightarrow \beta \rightarrow \varepsilon \rightarrow \delta$

(ii) $\beta^+ \rightarrow \gamma$ and, β and γ are independent.

Interestingly, all the four axioms, two of revealed preference and two of congruence, are proved to be logically equivalent under unrestricted domain. The Theorem 6 shows this. In fact, all the four axioms are found to be individually equivalent to ACC. It is already shown that ACC is equivalent to transitive rationality (TR). Thus, it follows logically that the TR is equivalent to the axioms of revealed preference.

The afore-mentioned theorems are as follows (Proofs are not shown here) :

Theorem 1 : A choice function C is

(1.1) rationalisable iff it is basic binary and
(1.2) basic binary iff it is binary.

Theorem 2 : The choice function C satisfies TR iff it satisfies ACC given by properties α and β^+.

Theorem 3 : WARP $\leftrightarrow$ ACC

Theorem 4 : The choice function C satisfies QTR iff it satisfies α, γ, and δ

Theorem 5 : The choice function C satisfies AR iff it satisfies properties α and γ.

Theorem 6 : SARP $\leftrightarrow$ WARP $\leftrightarrow$ WCA $\leftrightarrow$ SCA

IV. DOMAIN ISSUE AND IMPLICATIONS

In the previous section we considered the choice function C on the choice space (X, χ) where χ is the domain of C consisting of all finite nonempty subsets of X. What is important here is that there is no convincing reason for our restricting the domain of the choice function to the class of convex polyhedras representing budget sets in the commodity space. According to Sen, "it is not really necessary that even all finite sets be included in the domain. All the results and proofs would continue to hold even if the domain includes all pairs and triples but not all finite sets". Suzumura (1976) is of the view that there also exists no specific reason for our extending the domain so as to include all finite sets and thus he placed no restriction whatsoever on the domain of the choice function except that it is a "nonempty family of nonempty sets". However, it is Arrow who is the first person to suggest to broaden the domain of choice to include all nonempty finite sets so that WARP would be sufficient to imply the existence of ordering. This not only led to a different perspective and indeed to a different set of results but also, unlike the traditional revealed preference theory, helped studying and analysing choice behaviour of agents like a non-competitive consumer, a voter or a government bureaucracy.

The central point is that the rationale of freeing the traditional revealed preference theory from the fettered-form PQ $\leq$ M (where M, Q and P are total money income, commodity vector and price vector respectively) is proper and highly justified. Because, WARP is of considerable importance not because that it is empirically verifiable but it seems intuitively plausible. That is, WARP is being very often violated in real life situation. This is so because of the following two reasons : (i) WARP is based on 'observed behaviour' and it is not true that the whole budget set is observable; and (ii) even if the budget set is hypothetically given, WARP is likely to be violated because of the availability of variety of alternatives in the short-run and in the long-run owing to change in the tastes of individuals. For example, let x, y and z be three alternative dance-cum-music shows namely Odissi, Rock-n-Roll and Bhangra respectively. If an individual today enjoyed Odissi, $\Rightarrow xR_cy$. Suppose tomorrow he goes and watches Rock-n-Roll. This implies yR_cx and thus it is the variety of alternatives that violates WARP in the short-run. And in the long-run it may so happen that the individual who is an Odissi lover turns out to be a Bhangra lover because of some reasons, thus causing WARP to be violated.

Traditional revealed preference theory has been concerned with choices restricted to observable market situations only, i.e. confined to certain distinguished subsets of alternatives; in particular to a class of convex polyhedra (e.g. budget triangles in the two commodity case). Thus, traditional choice theory explained choice behaviour of "competitive consumers" only. Another important aspect that concerned modern choice theorists is that revealed preference theory is found to be almost exclusively obsessed with the transitive requirement of preferences of rational consumers. Because, according to the revealed preference theory, an individual choice behaviour is rational only when its preference relation is transitive. That is, for rationality it needs R to satisfy WARP. Say an individual's R violates WARP,

$\Rightarrow$ R fails to be a preference ordering

$\Rightarrow$ R, though total, is not transitive

$\Rightarrow$ inconsistent and hence irrational behaviour.

In passing, it is to be noted as Uzawa (1971) pointed out that two economists Ville (1946) and Houthakker (1950) independently argued that Samuelson's WARP is not sufficiently strong to ensure the existence of an ordering. It is their SARP which implies the desired result. Of course, Uzawa casting doubt on the independence of WARP and SARP, proves that "for demand functions with certain qualitative regularity conditions, Samuelson's Weak Axiom implies Houthakker's Strong Axiom".

The implication for rationality under restricted domain is noteworthy. Here under restricted domain, the complete equivalence of axioms no longer holds good. However, SCA remains equivalent to TR. In fact, Richter (1966), working under the Samuelsonian framework (see Gale, 1959) of restricted domain established that "a consumer is rational if and only if it is congruous". So Richter's rationality requirement, consistent with TR requires the agent to satisfy his congruence axiom, i.e. SCA. Sen (1971) termed this as Richter's congruence axiom (SCA) and provided its weaker version (WCA). In case of restricted domain, rationalizability is weaker than and not equivalent to AR but it can be shown that in case of unrestricted domain rationalizability is equivalent to AR. In the restricted domain framework, WARP is sufficient to guarantee rationalization but ACC cannot even guarantee that. Also, WARP does not give AR; QTR does not imply SARP. The choice function satisfying QTR can even violate WARP. All these can be shown by framing some counter examples.

Implications for Rationality

The implications for rationality, both for unrestricted and restricted domain framework, can be summarised through Figures 1 and 2.

Figure 1 : Unrestricted Domain

WARP — SARP — WCA — SCA
↕
ACC
↕
α & β^+ — α, γ & δ — α & γ
↕ ↕ ↕
TR — QTR — AR
↕
Rationalizability of C

Figure 2 : Restricted Domain

WCA
↕
SCA — SARP — WARP — ACC
↕ ↕ ↕
TR — QTR — AR — Rationalizability of C

COMMENTS AND CONCLUSION

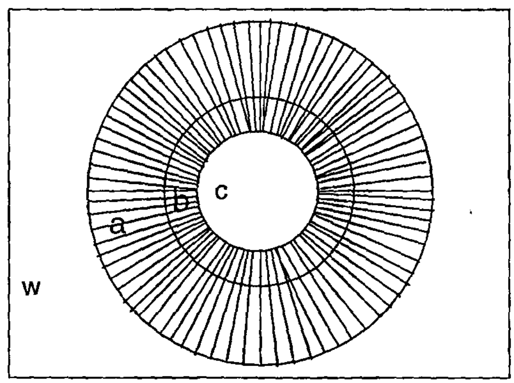
It is an undisputable fact that the contemporary modern theory of rational choice based on unrestricted domain framework is more scientific and so superior to the traditional theory of revealed preference based on restricted domain. No doubt, the traditional theory got its finer and fuller exposition when choices were no longer confined to a set of convex polyhedras. This helped to have an effective analysis of rational choice behaviour vis-a-vis choices other than that of pure consumption as well. We can, therefore, say that the traditional revealed preference theory is a theory of competitive consumer behaviour based on restricted domain whereas working on unrestricted domain what we get is the theory of rational choice where the actor or entity is any choice making agent and not the competitive consumer only.

Lap of Rationality Extended

It is not transitive but acyclic rationality that is the minimum rationality requirement in the theory of rational choice. It is, however, to be noted that triple acyclicity does not imply acyclicity over the whole set and hence it, *per se*, cannot serve the minimum rationality requirement. Consider, for example, the set of four alternatives x, y, z, w such that xPy, yPz, zPw, wPx, xIz, and yIw. No triple here violates acyclicity, but the whole set violates it, and there is no best element in the whole set, i.e. this gives us an empty greatest-point set. Therefore, even if an individual's preference relation is neither transitive nor quasi-transitive, the individual is a rational choice making agent so long as his preference pattern does not form a preference cycle. In other words, so long as $R \in R_A$, choice behaviour is rational as it ensures a non-empty greatest-point set, i.e. $G(A\ R) \neq \varphi$ iff $R \in R_A$. This is a wonderful result, and a notable contribution of unrestricted domain. And this is how the lap of rationality is expanded to include all those, who were hitherto not having a transitive or quasi-transitive preference relation and termed as irrational, into the rationality region.

Figure 3, which is a Ven-diagram, gives a candid illustration of the above point. The shaded area in it shows the extended rationality region.

Figure 3 : Rationality Region



The rectangle named w represents number of indivisuals in the world. The outermost circle denoted by 'a' refers to number of people satisfying acyclic rationality. Similarly, circles 'b' and 'c' stand for number of people satisfying QTR and TR respectively. Now, only 'c' individuals, given by the innermost circle, are rational as per the traditional revealed preference theory. But, as we have seen and is evident from the above figure, the individuals falling within the shaded region are also rational.

Room For Weaker Axioms

Another notable point is that all the four axioms are equivalent with only TR, the strongest rationality requirement, at a time when one will always want to dilute it in order to broaden the lap and horizon of rationality. So there is every point to look forward for some weaker axioms to be linked with weaker rationality requirements like QTR and AR. Figure 4 captures this contention in a summary format.

Figure 4 : Room for Weaker Axioms

Consistency Conditions	Rationality Requirements	Axioms
α & β^{+}	TR	WARP
		↕
		SARP
		↕
		WCA
		↕
		SCA
α, γ & δ	QTR	?
α & γ	AR	?

Rational Fools

Man is a social animal. Sometimes he finds himself feeling a sense of commitment to the social relations sorrounding him, say to the neighbourhood or to the social class to which he belongs. Furthermore, man is not only body and mind, he is the spirit. So it is not fully justified to overlook the emotional, spiritual and the commitment based dimension of a human being while discussing and describing 'who is rational'.

As is well-known, most part of the theory of rational choice is based on the concept of an "economic man". The theory tends to reduce man to a self-seeking egoist. It even tends to suggest that people are honest only to the extent that they have economic incentives for being so. Sen considers this to be a homo oeconomicus assumption which is far from being obviously true, and which needs confrontation with observed realities. In the theory, usually a person is given one preference ordering, supposed to reflect his interests, summarise his idea of what should be done, and describe his actual choices and behaviour. Given the situation, the rational man acts as a maximizer and settles for nothing less than the best. Revealing no inconsistencies in his choice behaviour deems him to be rational. At this point there is every reason to put a question mark on the socalled rational men and at the same time there is no less justification to term them "rational fools". In the words of Sen, "the purely economic man is indeed close to being a social moron. Economic theory has been much preoccupied with this rational fool decked in the glory of his one all-purpose preference ordering" (see Sen, 1977).

As a critique of the behavioural foundations of economic theory, Sen maintains that the main thesis has been the need to accommodate commitment as a part of behaviour. He argues that traditional theory has too little structure to take care of this dimension. A step has been taken in this regard by John Harsanyi through his "dual structure" which, by bringing important distinction between a person's 'ethical' preferences and his 'subjective' preferences, permits us to distinguish between what a person thinks as good from the social point of view and what he regards as good from his personal point of view (Sen, 1977). Sen feels that, " presumably sympathy enters directly into the socalled subjective preference, but the role of commitment is left somewhat unclear". However, "I have tried to analyse the structural extensions in the conception of preference made necessary by behaviour based on reasoned assessment of commitment. Preferences as rankings have to be replaced by a richer structure involving meta-rankings and related concepts."

To conclude, it would be in the fitness of the things if one makes room for different dimensions related to human behaviour like behaviour based on commitment, behaviour influenced by ethical and emotional compulsions, etc., before adjudging choice making agents as irrational animals. The fact is that we are still short of structure and this calls for a more elaborate one.

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