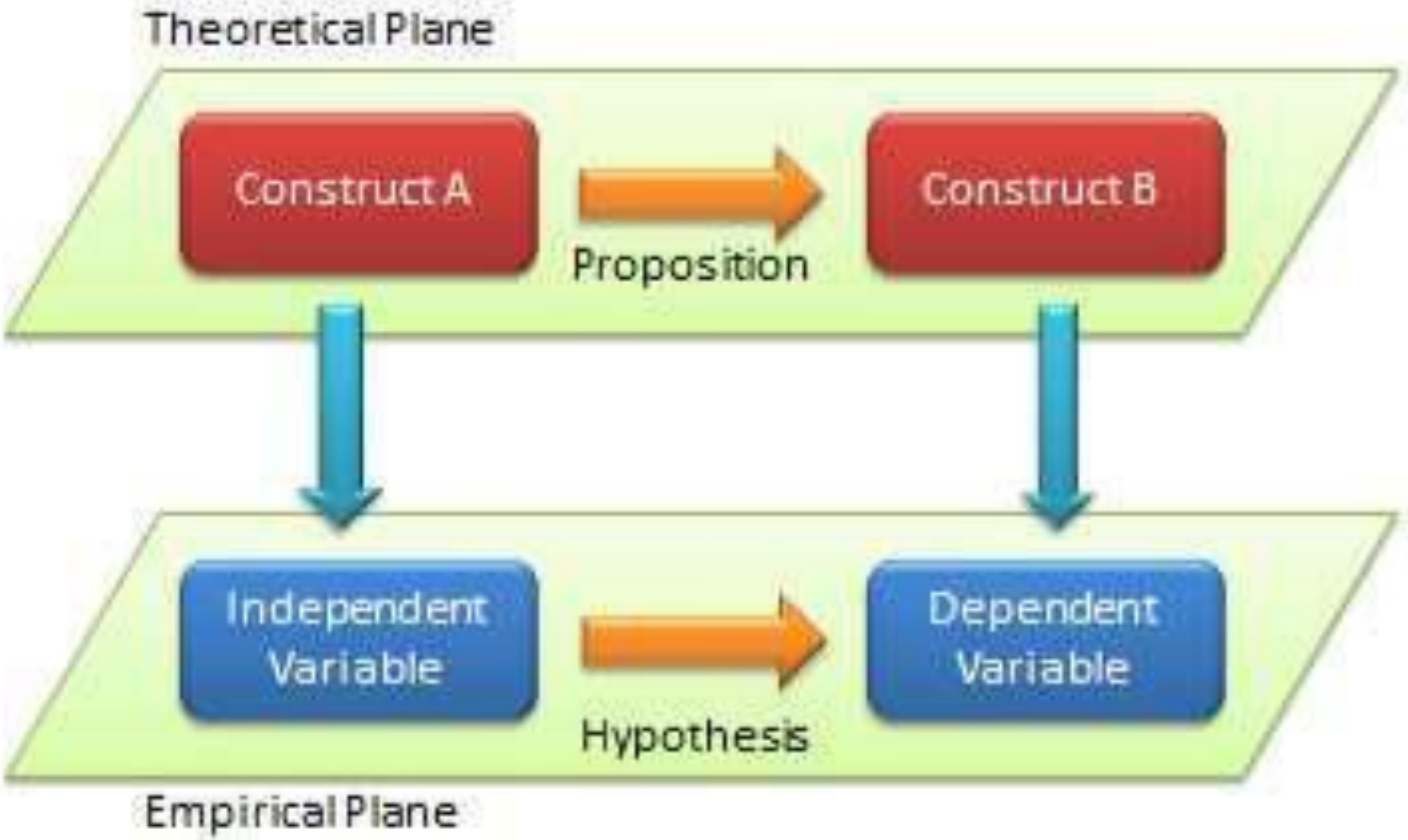
Theories and Assumptions

PROFESSOR RAVI KIRAN

Theories and Assumptions

- **Theories consist of abstract statements that relate a set of fundamental concepts.**
- **General or 'law-like'** statements are a **key ingredient of theories** that enable us **to formulate hypotheses about these empirical relationships.**
- Take the **law of demand**, for example, or the proposition that postulates that **economic agents act such as to maximize their utility over attainable outcomes.**
- Initial conditions, together with a law-like statement of this kind, **allow the formation of a hypothesis or prediction as to how prices, or individuals, will relate to those conditions and any ensuing changes in them.**



The distinction between **propositions (formulated at the theoretical level) and hypotheses (tested at the empirical level)** is depicted in above Figure .

Distinction between **propositions and hypotheses**

- **Propositions are associations postulated between constructs based on deductive logic.**
- **Propositions are stated in declarative form and should ideally indicate a cause-effect relationship** (e.g., if X occurs, then Y will follow).
- Note that propositions may be conjectural **but MUST be testable**, and should be rejected if they are not supported by **empirical observations**.
- However, like constructs, **propositions are stated at the theoretical level**, and they can only be **tested by examining the corresponding relationship between measurable variables of those constructs**.
- The **empirical formulation of propositions, stated as relationships between variables, is called hypotheses .**

Theories and Assumptions

- In modern economics, theories are usually expressed in **terms of a collection of models.**
- Let us consider **game theory or principal agent theory or the theory of the firm.**
- In each case, we have a collection of **standard models that together seek to address key features of their domain of application.**
- The **theory of the firm combines models addressing various aspects of corporate governance and internal organization.**
- Game theory combines a family of **models studying strategic interaction.**

Theories and Assumptions

- The principal–agent problem, in political science, supply chain management and economics occurs when one person or entity, is able to make decisions and/or take actions on behalf of, or that impact, another person or entity.
- **Principal agent theory** seeks to **explain basic contracting relationships between two parties.**
- However, both principal agent theory and non-cooperative game theory are core building blocks of the modern theory of the firm.

Theories and Assumptions

- A simple model in **demand theory predicts that if the price of a good rises, the quantity demanded will fall, other things being equal.**
- Any hypothesis of this kind is based on certain assumptions or premises, although these are sometimes implicit in the formulation of the model or theory, rather than explicit.
- The **nature, role and interpretation of these assumptions often leads to controversy, in particular if more than one prima facie plausible model is conceivable**.
- At this stage, **methodological considerations** enter the picture and may tip the balance in favor of one alternative over the other.
- In economics, this has traditionally been discussed as part of a general debate on the role of assumptions in economic theorizing.

Theories and Assumptions

- Friedman (1953) claimed that the scientific worth of a theory is determined purely in terms of the **predictive power of the hypothesis that can be generated from it.**
- According to Friedman, the issue is thus not primarily **one of identifying realistic assumptions** as the **primary building blocks of a theory,** but to **judge the value of the particular assumptions chosen in the light of how well the theory, or a particular model formulated within that theory, is able to account for the phenomena under study, and how they change.**

Good Theory

- A good theory that makes **accurate predictions** means that individuals behave **'as if'** they follow the behavioral assumptions, even if those turn out to be descriptively inaccurate at some level of abstraction.
- Most economists, including critics of the standard model of economic rationality, agree regarding this aspect of the role of assumptions, and concede that **economic theories cannot be rejected on the basis of their assumptions alone,** however unrealistic these may appear to be.
- Additional considerations are involved, such **as their inability to make accurate predictions, as Friedman would have it.**

Behavioral Economics

- Behavioral economics often proposes **'process' models** as opposed to **'as-if' models**.
- '**As-if' models aim at predicting overt (open) choices**.
- **Process models**, based on psychology, aim at **predicting choices**, **while also modeling and predicting the processes that produce them.**
- With a **process model** it can be claimed that if it fails to predict a particular process, such a process is **factually falsified.**
- Since this **process may be an assumption in another model,** it may be possible for a study examining a process model to prompt the rejection of an assumption in a different theory.
- However, it may be claimed that economic **'as-if'** models **are immune to this problem**, since, **even if a process is falsified, the underlying assumption is only that people behave as if the process operated.**
- The **litmus test** relates to the ability of a model to explain and predict.
- **[Brandstätter, Gigerenzer, and Hertwig, 2008; Johnson, Schulte-Mecklenbeck, and Willemsen, 2008; Glimcher, 2009)]**

Methodological Stance

- Some economists, notably **Gul and Pesendorfer (2008),** have argued that **the assumptions described above are not to be treated as axioms or fundamental premises that are 'self-evident'.** They claim instead that, as far as the rationality of agents is concerned, this is **not an assumption in economics** but a **methodological stance**.
- **It is possible to demonstrate the *usefulness* or lack of usefulness of experimental methods.**
- If various types of experiment fail to predict behavior in the real world, then it could be claimed that such methods are not useful.
- The important point here is that, although **theories cannot be falsified simply on the basis of their assumptions, these assumptions, or methodological stance, may be shown not to be useful, at least in certain circumstances.**

Evaluating Theories

- **What constitutes a 'good' theory?**
- There are various criteria that scientists in general propose as being relevant in terms of evaluating theories.
- Stigler (1965) proposes three essential criteria for judging economic theories:

i. congruence with reality,

ii. generality and

iii. tractability.

iv. The evolutionary biologist E.O. Wilson adds a further criterion, **parsimony,** which ironically is particularly pertinent for the standard model of economic rationality.

What constitutes a ‘good’ theory? Congruence with Reality

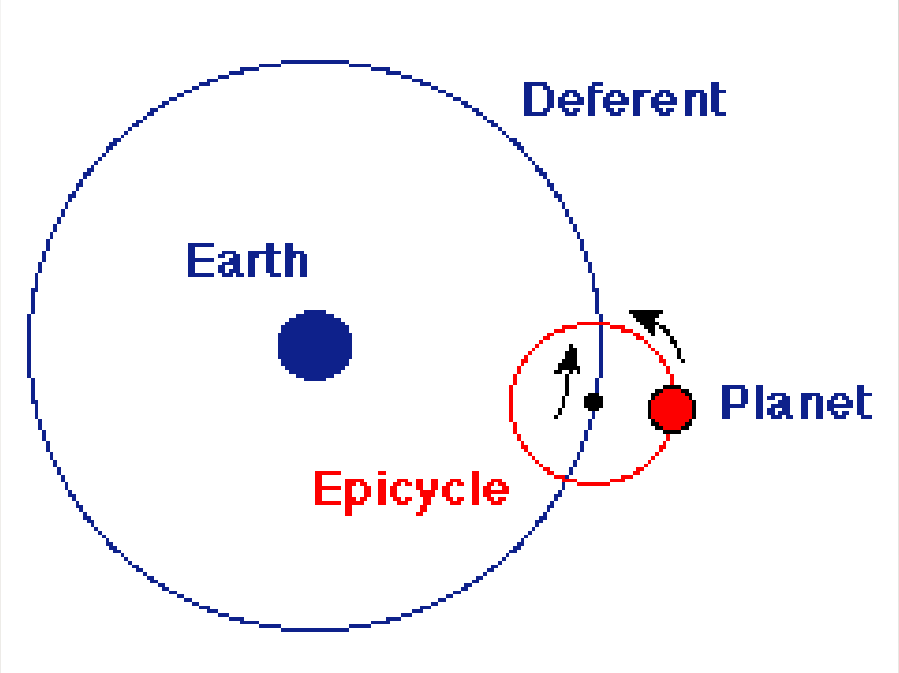
- Good theories are able **both to explain or fit existing observations, and to make testable predictions that later prove to be correct.**
- In this respect **Newton’s laws of motion** represent a **good theory**, but not as good as **Einstein’s theory of relativity**, since they do not fit reality as well on a cosmic scale.
- It is notable that **such theories are sometimes referred to as ‘laws’,** in the sense that they **represent regularities**; this is particularly applicable when such ‘laws’ involve **general principles with widespread application, which is the subject of the second criterion.**

Congruence with Reality

- **Models can be made to fit data better by adding more adjustable parameters, but by explaining more they lose predictive power.**
- For example, **in astronomy Ptolemy's geocentric system with epicycles**, proposing that **all the planets and the sun move around the earth in complicated orbits, fitted existing observations better than Copernicus's later heliocentric theory.**
- **The relationship between fitting and predicting has aroused considerable controversy in experimental economics.**
- A model's predictions should always be tested with new data that were not used to estimate the model originally (Binmore and Shaked, 2010a).

Congruence with Reality

- Ptolemy believed that the heavenly bodies' circular motions were caused by their being attached to unseen revolving solid spheres. For example, an epicycle would be the **"equator" of a spinning sphere lodged in the space** between two spherical shells surrounding Earth.
- An epicycle is basically a little "wheel" that orbits on a bigger wheel.



Nicolaus Copernicus : **Heliocentric theory**

- Nicolaus Copernicus was an astronomer who proposed a heliocentric system, that **the planets orbit around the Sun**; that Earth is a planet which, besides orbiting the Sun annually, also turns once daily on its own axis; and that very slow changes in the direction of this axis account for the precession of the equinoxes.
- Equinox is a unique phenomenon **during which the earth's day and night are of equal length resulting in 12 hours of daylight and 12 hours of night in every part of the earth**.

Generality

- **Good theories apply to a wide selection of phenomena.**
- Newton's and Einstein's theories qualify, but **Einstein's may be preferable in terms of applying to a larger range of situations.**
- Theories of **quantum mechanics and evolution by natural selection** are further examples of general theories.
- In economics Examples include **the law of diminishing returns** (although strictly speaking, this is a direct implication of the core axioms of economic rationality), **consumer theory and the law of demand, and the theory of comparative advantage.**

Tractability

- **Tractability** refers to **how easy it is to apply theoretical models to different situations in terms of making testable predictions**.
- In practice **this relates in particular to the complexity of the theory involved**.
- More complex theories **take into account more parameters (usually by making fewer assumptions) and are, therefore, more difficult to represent as models.**

Tractability

- In many sciences, including economics, models are often best represented in mathematical form.
- There are two reasons for this:

i. **Mathematics allows the theory to be represented most concisely and unambiguously, including the assumptions involved**;

ii. **Mathematics allows manipulation to be performed, resulting in precise predictions for given values of the parameters involved in the model.**

- However, **highly complex theories may prove to be somewhat intractable** if the resulting mathematical analysis becomes unmanageable.
- In practice there is often a **trade-off between tractability and parsimony.**

Parsimony

- Parsimony refers **to the principle of Occam's razor**, named after the philosopher
- William of Occam, and first expressed in the 1320s said, '**What can be done with fewer assumptions is done in vain with more.'** In the words of E.O. Wilson (1998, p. 57):
- **Scientists attempt to abstract the information into the form that is the simplest and aesthetically the most pleasing – the combination called elegance – while yielding the largest amount of information with the least amount of effort.**
- **The Copernican theory** was more **simple or parsimonious** than the **epicycle theory.**
- [Parsimony: extreme unwillingness to spend money or use resources]

Parsimony

- By assuming that **economic agents are selfish utility maximizers the standard model is able to derive a large number of predictions regarding the behavior of individuals and firms.**
- However, there may be another **trade-off here**:
- if a theory is too parsimonious it may not satisfy the first criterion (congruence with reality) so well, **since it may make too many assumptions to apply to real-world situations.**
- This is the main criticism **behavioral economists level at the standard model since it cannot explain the anomalies described earlier, or indeed many others.**

Reductionism

- **Reductionism is a vital key to success in developing sciences.**
- Reductionism is a means of **relating explanations at different levels of science to each other and integrating them into a whole.**
- A **radical reductionist** would accept that all theories about the material world, including its organisms and their interactions, can ultimately **be reduced to the level of physics.**
- This claim is highly controversial even in the sciences, let alone the social sciences.
- **Ernest Rutherford** is famously reported to have said: '**All science is either physics or stamp-collecting'**
    - (in J.B. Birks, *Rutherford at Manchester* (1962), p. 108).

Evidence

- Traditionally there has been a contrast between the empirical methods used by economists and those used by psychologists.
- Economics has **traditionally relied on using field studies to test theories empirically**, whereas **behavioral economics follows psychology in using experimental studies to a greater degree.**

Types of empirical study

- There are two main types of study in general terms that can be conducted.

i. **field study**,

ii. **experimental study**

- Either type of study can be **between subjects or within subjects.**
- A **between-subjects** study **examines differences between two or more groups of people, each of which is given a different task or series of tasks.**
- One group may be asked to **state preferences relating to rewards a week from now**, while **another group is asked to state preferences relating to rewards a month from now**.

Types of empirical study

- A **within-subjects** study **examines different responses from the same subjects, which necessitates each subject performing a series of at least two tasks.**
- For instance, **subjects may be asked to state preferences relating to rewards both one week from now and one month from now.**
- Thus, in some circumstances the first type of study is preferable or is the only practical possibility, while in other circumstances the second type of study is preferred.

Field and Experimental study

- Both Economists and Psychologists use empirical studies in order to test their theories, however economists rely more on field studies, while psychologists have relied largely on experimental studies.
- There have been **three main reasons** for this:

i. Economists are primarily concerned with studying behavior **– what people do;** this is shown **by their revealed preference** in terms of **what products they buy**. Psychologists are primarily concerned with studying motivation **– why they behave as they do.**

Field and Experimental study

- For a long time, the prevalent view in economics has been that **it is often impossible or impractical to use experiments in economic situations, as the researcher may lack the relevant control.** Even when such control is possible, as when an economic adviser is able to influence or determine government policy, **experimentation may have damaging or unethical consequences**.
- **Governments may be unwilling to experiment with tax levels** (for example, based on the infamous Laffer curve), or **with using different policies for different groups** (for example, by giving educational vouchers to one group and general subsidies to another).
- iii) Economists have also been more concerned with **studying the behavior of groups of agents, in particular markets, rather than single individuals.**

Field studies

- Field studies **involve observing real decisions that people make in their lives.** The following are examples of situations involving such types of study:
- **1** Choices involving buying different electrical appliances, where some are more expensive, but save electricity and reduce costs during their lifetime.
- **2** Life-cycle saving behavior.
- **3** Choices of betting in horse races.
- **4** Investment choices, involving buying and selling stocks and bonds.
- **5** Choices of smokers and drug addicts which involve **trade-offs** between current benefits and long-term costs.
- **6** Shopping choices where **consumers respond to different promotional offers**.

Advantage of field studies

- The advantage of field studies compared with experimental studies is their **high level** of **ecological validity**.
- This means that there is no concern that the results do not apply in reality, for the simple reason that the results are by necessity real. However, this does not mean that the results are **conceptually valid**, meaning that they actually succeed in measuring what they are supposed to measure.
- This is because field studies (and experimental studies also to a lesser extent) may be subject to a number of **confounds**.
- A confound occurs when a result or reported value is a conflation of two or more effects which are not, or cannot be, isolated from each other. **The problem of confounds is very common in economics, and makes it difficult to choose between different competing theories or explanations where they are both supported by the same facts.**

Field studies

- When people buy inefficient but cheaper electrical appliances this may not be because they discount future cost savings at a high rate.
- Various other factors may be relevant:
- (1) people may be ignorant of the future cost savings;
- (2) people may be informed about future cost savings but disbelieve them or regard them with a large amount of uncertainty;
- (3) people may have cash constraints that do not permit a higher current expenditure;
- (4) there may be hidden costs related to buying more efficient appliances, in terms of greater maintenance or reduced reliability; or
- (5) people may be incapable of translating the relevant monetary information into a basis for decision-making and simply make a random choice, or choose out of habit or current convenience.

Economists Defence

1. The assumptions are merely a methodological stance; the standard model makes no claim to say anything about the underlying psychological processes of agents.
2. Markets average out individual deviations in behavior; individuals who deviate will tend to be eliminated from the market by competitive forces similar to natural selection.
3. The experiments of psychologists tend to be flawed.

Experimental studies

- Exp**erimental studies** involve **asking subjects to evaluate either real or hypothetical prospects that are manipulated by the investigator.**
- The experimental approach **traditionally used by psychology** has significant advantages over the **observational approach** in terms of control over the relevant variables, allowing investigators to manipulate them in order to determine their influence directly.
- For example, one group of subjects may play a game of chance against a player who is shabbily dressed and deliberately acts diffidently, while another group may play the same game against a professionally dressed and confident opponent.
- **Evidence indicates that subjects bet more against the first type of player**, even though the outcome of the game is entirely governed by chance.

Experimental studies

- In experimental studies either real or hypothetical rewards and costs can be used. These do not have to be monetary in nature, but **may relate to health or levels of comfort and discomfort.**
- The obvious advantage of using **real rewards is that subjects are more motivated to act in ways that correspond closely to their behavior in real life, and such studies are, therefore, more likely to yield accurate predictions.**

Experimental studies

- However, there is also an advantage of using **hypothetical outcomes** in terms of flexibility; it is possible to use both large rewards and losses in this case, as well as using longer time delays in intertemporal studies.
- A study by **Kirby and Marakovic (1995**) compared discounting under both kinds of situation, **using 30 permutations of five different rewards (between $14.75 and $28.50) and six different delays (between 3 and 29 days).**
- The conclusion was that discount rates were lower for hypothetical rewards, and this was also the conclusion of Coller and Williams (1999) in a different type of study, although in this case the results were more ambiguous.

Experimental Methods

- There are three main issues that have been raised relating to the experimental methods used in behavioral economics.

i. **experimental design**

ii. **the interpretation of experimental results**

iii. **the need to evaluate assumptions as a set**

Experimental Design

- Experimental design is the **process of carrying out research in an objective and controlled fashion** so that precision is maximized and specific conclusions can be drawn regarding a hypothesis statement. Generally, the purpose is to establish the effect that a factor or independent variable has on a dependent variable.

The use of financial incentives

These incentives are used in order to motivate participants.

They are widely used in economic experiments, but not in psychological ones.

Economists tend to believe that financial incentives are vital in order to ensure that subjects behave in the same manner that they would in the real world and that they invest appropriate cognitive attention to the demands of the experiment.

Psychologists frequently counter that such incentives may distort the results, by vitiating the intrinsic interest that subjects may have in participating in the experiment.

The use of deception

- Another criticism of **many psychological experiments** is that the necessary manipulation involves a deception of at least some of the subjects.
- A number of studies, in particular by Hertwig and Ortmann (2001), have indicated the widespread use of deception in experimental studies, with between 30% and 50% of studies published in top journals like the *Journal of Personality and Social Psychology* and the *Journal of Experimental Social Psychology* using deception.

The use of deception

- Deception is often justified by practitioners on two grounds.
- First, it allows investigators to create situations that they would not otherwise be able to observe under normal circumstances, such as how people react in emergencies.
- Second, and more important, it enables the investigator to camouflage the real purpose of the experiment from the subjects, in order to prevent them reacting strategically and producing a misleading result.

Lack of control

- A final problem relating to **experimental design** is that economists often criticize experiments performed by behaviorists for their lack of control, resulting in a misinterpretation or confounding of effects.
- This is particularly important when the objective is the elicitation of subjects' preferences. A good illustration of this relates to the endowment effect.
- **Endowment Principles Endowment effect – We ascribe more value to objects / things merely because we own them. Even when that ownership is only for a few minutes long, people tend to value items they own more than items that they do not own. People would pay $4.00 for a coffee cup (before they owned it) People would only sell the same coffee cup for $6.00 once they owned it**
- Some studies show a **strong endowment effect**, with sellers demanding **twice the price that buyers are willing to pay,** while other studies with different experimental protocols show no endowment effect at all.

Interpretation of experimental results

- One problem here relates to the concept of ecological validity mentioned earlier. Can insights gained in the laboratory be extrapolated to the world beyond?
- If results cannot be generalized in this way they are of very limited value as far as forming the basis for a good theory, as we have seen in the section on evaluation of theories.
- In the physical sciences extrapolation is not usually such a problem, since the physical laws of nature are the same everywhere, but the study of humans (and animals) presents problems.

A set of assumptions needs to be evaluated as a whole

- Fudenberg (2006) observes that the normal approach in developing theories in behavioral economics has been to modify one or two assumptions in the standard model in the direction of greater psychological realism.
- Fudenberg points to the dangers of this step-by-step approach, particularly in the analysis of equilibrium and strategic interaction, and in self-control theories.
- Relaxing one assumption may have a 'knock-on' effect on other assumptions, making the new set inconsistent, and this needs to be taken into consideration. Therefore modelers need to take all the assumptions as a set and see how many need to be modified in order to end up with a new set that is self-consistent.

- Issues raised in behavioral economics include experimental design, the interpretation of experimental results, and the need to evaluate assumptions as a set.