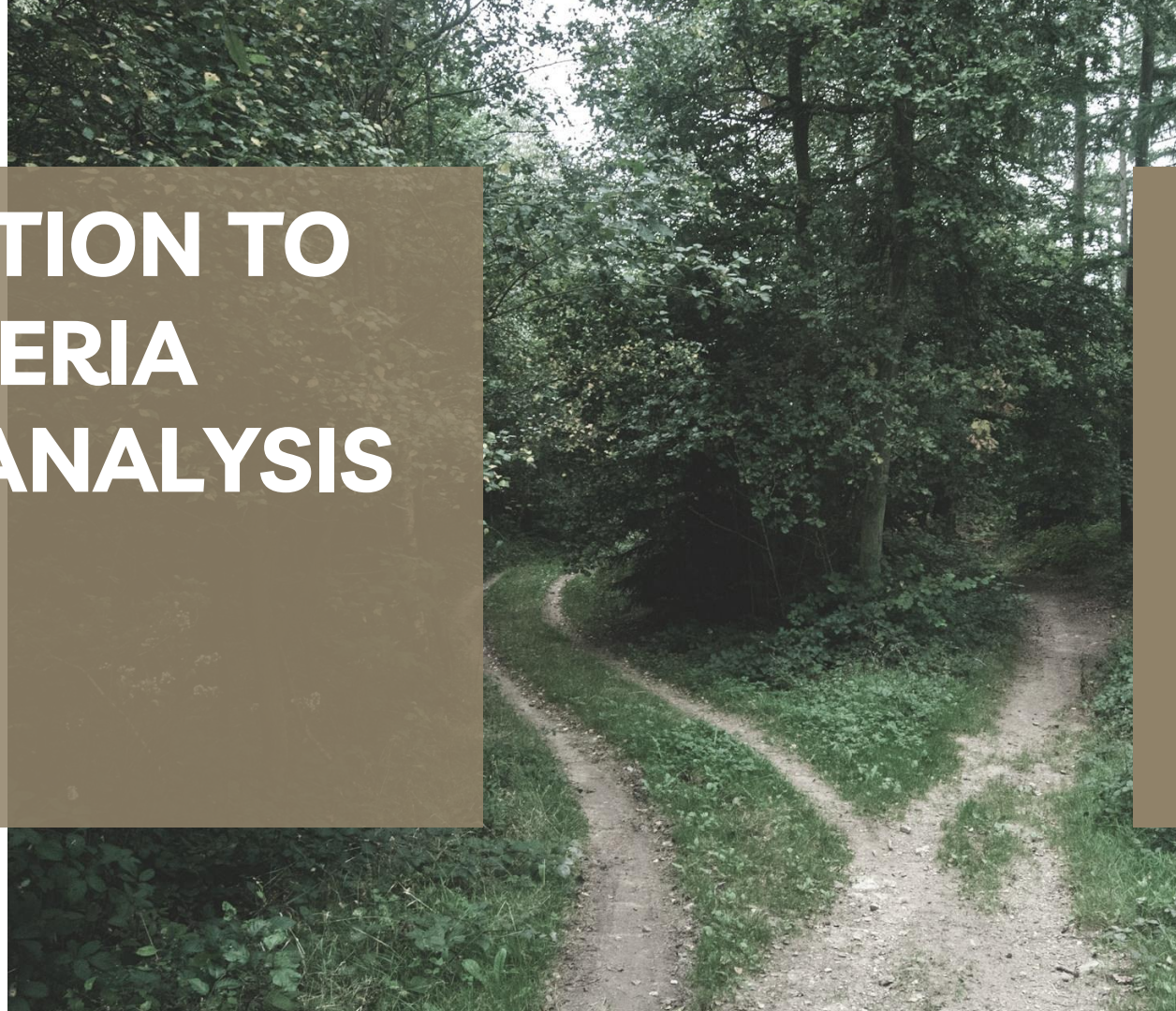
INTRODUCTION TO MULTICRITERIA DECISION ANALYSIS (MCDA)

01 – General Decisions

Fellipe Martins



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INSTRUCTOR RESUME

Your instructor – Fellipe Silva Martins:

1. A little bit of **information** about me:
    - Bachelor's Degree in Foreign Languages Applied to International Negotiations (Universidade Estadual de Santa Cruz / Université de La Rochelle)
    - Master's Degree in Production Engineering (Production Management, and Optimization) (Universidade Nove de Julho)
    - Ph.D. in Business Administration (Strategy) (Universidade Nove de Julho)
    - Postdoctoral Fellowship in Production Engineering (Universidade Nove de Julho)
    - Ph.D. in Information Science (ongoing) (Universidade de São Paulo)
    - Former Professor of the Master's/Ph.D. Program in Information Technology and Knowledge Management (Universidade Nove de Julho)
    - Professor of the Master's/Ph.D. Program in Business Administration (Universidade Mackenzie)
    - Former Editor-in-Chief (currently Associate Editor) of Revista de Administração Mackenzie (RAM)
    - Former Associate Editor of Revista Iberoamericana de Estratégia
    - Associate Editor of Revista Brasileira de Marketing
    - Leader of the Behavioral Strategic Management track at ANPAD

THIS COURSE

This course:

1. This is a **brand-new course**, so we're going to build it from the ground up together.
2. I'll do my best to **keep it light on math and formalism**, ensuring that students from all research lines can enjoy and benefit from it.
3. But we can't run from the fact that MCDA is an inherently quantitative field, **most of the papers we'll be reading contain some (and sometimes a lot of) math**.
4. This will also be **a hands-on course** (projects, presentation, software, etc.). Bring a computer to class if you can.
5. You will **develop a full paper** up to two weeks after the end of the course, stemming from this course (methods, etc.). We will work during the class as well.
    1. Paper = 50%
    2. Presentation = 20 %
    3. Class participation 30 % (includes weekly reports)
6. I hope you **submit this paper to EnANPAD 2025** (by April, most likely).
7. Whoever gets accepted in EnANPAD (with a paper from this course, obviously), automatically gets an A (subject to approval from PPGA's coordination).
8. MCDM is not for everybody. You can choose to drop out. I won't feel bad, no harm feelings! Just remember there is a deadline for dropping out.

Getting married or buying a bike?

It may seem stupid or pointless but nonetheless it is an interesting question.

1. **In trios, develop a plan about how to help someone make this decision**
2. **Present your plan, give feedback, receive feedback from other groups**
3. **If you already know something about MCDA, please don’t kill the buzz**

Commuting - the best way?

You need to get to work, using the subway or by car. You have a subway station close to home/work and there is parking space at your workplace.

1. **Do the same as before**
2. **Again, if you already know something about MCDA, please don’t kill the buzz**

WHAT WE LEARNED SO FAR

UNCERTAINTY

Traffic conditions may cloud your judgment, you may not be a good driver, you make it to the subway station to find it is not working because of some incident.

PERSONAL HEURISTICS

Always taking the same route out of habit.

EXTERNAL CONSTRAINTS

Your car battery is dead, there is a subway workers' strike and so on.

PERSONAL PREFERENCES

You'd rather take an extra half an hour than be in a packed train.

Where to go on vacation?

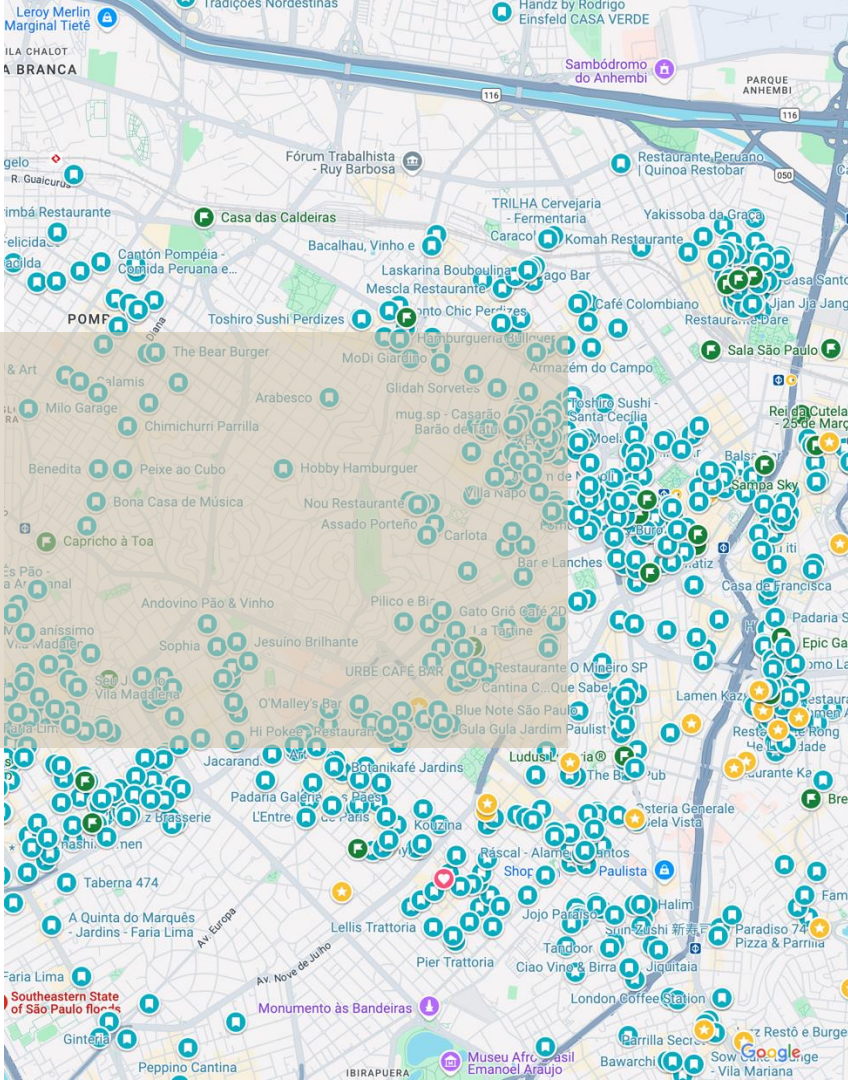
Now you will help me define the destination of our (me and my wife's) next vacation: Japan, Scotland, Israel, or South Africa?

1. **Do the same as before**
2. **Again, if you already know something about MCDA, please don't kill the buzz**
3. **If you follow me on Instagram you already know what we decided, but try to understand why we did it.**

Where to go for lunch?

This is my real map of restaurants I like, or want to go in São Paulo

1. **Do the same as before**
2. **<u>Again</u>, if you already know something about MCDA, please don’t kill the buzz**
3. **If you follow me on Instagram you already know that I really like going out for food.**



WHAT WE LEARNED SO FAR

STAKEHOLDERS

More than one people means more people thinking about the problem (yay!) but also more complexity (oh no!).

TRADE-OFFS

Distance or familiarity? Shorter or longer period? Safety or adventure? Etc...

EXTERNAL INFLUENCE

Come on, I know you save some travel videos on Instagram.

DECISION FATIGUE

As the options pile up it gets increasingly tiring to make comparisons and decide.

Best supplier for your company?

Think about trying to sell up a supplier as an option to the CEO.

1. **Bla bla bla you know what to do**

Best place to build a nuclear plant?

Think about all the considerations that must be done in order to choose the best place.

1. **Just one more and we’re done**

WHAT WE LEARNED SO FAR

CONSTRAINTS

Long versus short-term impact, safety, environmental impact, regulatory issues

CONFLICTS

Divergning stakeholders (government, environmental groups, local communities, industry)

INTERDEPENDENCIES

Things are not so clear, and there is dependence on what we know

RISK

Especially with high risk, the consequences have to be considered

MAJOR REQUIREMENTS

PROBLEM

Usually we make decisions when we have to, due to problems or consequences

PEOPLE

Unless it is automated system, people (more than one) are usually involved in the decision making processs

INFORMATION

We use to make the decision making process clearer and helps us consider things

OPTIONS

We end up coming up with a list of potential options and usually choosing one

PROCESS

You need some process to get to the final option(s), can’t leave it up to chance alone

LOGIC

You need logic otherwise it is just random luck

“UNAIDED” DECISIONS

intuitive decision making, without the
support and structure
provided by the decision-analysis methods

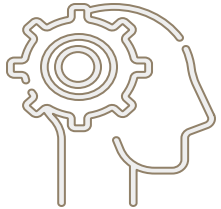
"UNAIDED" DECISIONS

Decision Makers Use a Mental Toolbox

- Psychologists suggest that decision makers have a **mental toolbox of strategies**.
- These strategies are adaptive, meaning **people select the one they believe best fits the situation**.
- Herbert Simon (1957) introduced the concept of **bounded rationality** - humans cannot process all information optimally.
- Instead, people use **approximate methods to find satisfactory, rather than perfect, solutions**.
- These approximate methods are known as **heuristics** - simple rules of thumb for decision-making.
- **Heuristics help people deal with complex problems quickly and efficiently, but they can also lead to biases.**

Heuristics and Their Adaptation to the Environment

- These strategies are adaptive, meaning Simon and Gigerenzer emphasize that **heuristics are often well-matched to an individual's knowledge and environment**.
- People develop heuristics based on **patterns they recognize** in their surroundings.
- Example: *If research funding is the best indicator of a university's quality, a student using this single factor as a decision rule could still make a good choice*.
- Even though it ignores other factors (sports facilities, teaching quality), **this heuristic works because it aligns with real-world correlations**.
- This demonstrates that **heuristics can be both simple and effective**, depending on the decision context.



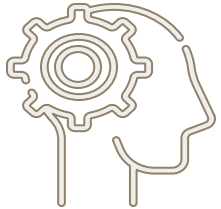
"UNAIDED" DECISIONS

Fast and Frugal Heuristics

- Gigerenzer and colleagues introduced the term **fast and frugal heuristics** to describe decision-making shortcuts.
- These heuristics are especially useful when **time is limited or information is incomplete**.
- Rather than analyzing every possible alternative, people **make decisions quickly using a few key pieces of information**.
- Example: *When choosing a product, a consumer may rely only on brand recognition instead of reading detailed reviews*.
- While these heuristics save time and effort, they may sometimes **lead to suboptimal choices or biases**.

Choosing the Right Heuristic for the Situation

- People do not use heuristics randomly - they select the **one that best fits the decision problem**.
- The effectiveness of a heuristic depends on **how well it matches the decision environment**.
- For simple or time-sensitive decisions, heuristics can be a great shortcut to effective choices.
- However, ***in complex decisions, relying too much on heuristics can lead to mistakes or oversimplifications***.
- Understanding how and when to use heuristics is essential for better decision-making strategies.



"UNAIDED" DECISIONS

Minimalist strategy

- **Step 1**: Apply the recognition heuristic. If one option is recognized, choose it.
- **Step 2**: If neither option is recognized, guess.
- **Step 3**: If both options are recognized, select a **random attribute to compare** them.
- **Step 4**: If the selected attribute distinguishes the options, make the decision.
- **Step 5**: If not, **pick another attribute at random**, repeating until differentiation is found.

- Example: Choosing between two digital cameras—if both brands are recognized, randomly pick an attribute like "movie shooting mode."

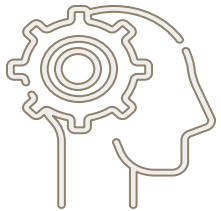
- **Key Difference: Random attribute selection for decision-making.**

Take the last strategy

- **Step 1**: Apply the recognition heuristic. If one option is recognized, choose it.
- **Step 2**: If neither option is recognized, guess.
- **Step 3**: If both options are recognized, **recall the attribute used in the last similar decision**.
- **Step 4**: If the recalled attribute distinguishes the options, make the decision.
- **Step 5**: If not, use the attribute from the previous decision before that, and so on. If none work, use the minimalist strategy.

- Example: Choosing between two digital cameras—if both brands are recognized, randomly pick an attribute like "movie shooting mode." Example: Choosing an airline—if the last flight was chosen based on catering quality, the person uses the same criterion again.

- **Key Difference: Relies on past experience to guide attribute selection.**



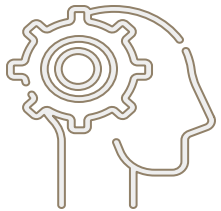
The Lexicographic Strategy

- **Analogy**: Works like dictionary ordering - e.g., "bat" and "ball" tie on the first two letters, but "ball" is ordered first due to the third letter.
- **How** It Works:
  - 1. Identify the most **salient** attribute (e.g., price when buying a car).
  - 2. Choose the option that performs best on that attribute.
  - 3. If there is a tie, move to the second most important attribute (e.g., size).4. Repeat until a decision is made.

- **Advantages**:
  - Simple and fast (**low cognitive effort**).
  - Effective when **one attribute dominates** all others in importance.
  - Useful in **low-information environments**.

- **Limitations**:
  - Ignores potentially useful information.
  - Overly simplistic when all attributes are relevant.

- Note that the lexicographic strategy is ***non-compensatory***.
  - **With deeper reflection, a decision maker might have preferred an option that performed less well on the most important attribute because of its good performance on other attributes.**



The Semi-lexicographic Strategy

- **Definition**: Similar to the lexicographic strategy but **allows small differences in an attribute to be treated as a tie**.
- **Decision Rule Example**: *"If the price difference is less than $0.50, choose the higher quality product."* Otherwise, choose the cheaper brand.

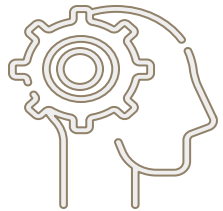
Brand	Price	Quality
A	$ 3.00	Low
B	$ 3.60	High
C	$ 3.40	Medium

- If you were to employ this strategy then you would prefer
  - **A to B** (price > 0.50, higher quality) and
  - **B to C** (price < 0.50, cheaper product)

- This implies that you will prefer **A to C** (if A > B, and B > C, then A > C) but a **direct comparison of A and C using the strategy reveals that C is preferred** (price < 0.50, higher quality).

- **This set of choices is therefore contradictory**.

- More formally, **it violates a fundamental axiom of decision analysis that is known as transitivity**, which states that **if you prefer A to B and B to C then you should also prefer A to C**.



"UNAIDED" DECISIONS

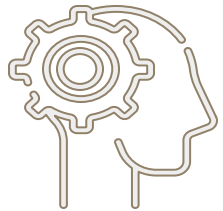
Elimination by Aspects (EBA)

- **How It Works**:
- 1. Identify the most salient attribute and set a cutoff point.
- 2. Eliminate all options that do not meet the cutoff.
- 3. Repeat the process with the next most important attribute until only one option remains.

- **Example: Buying a Car**
  - Step 1: Price → Eliminate cars above $15,000 or below $6,000.
  - Step 2: Seats → Eliminate two-seater sports cars.
  - Step 3: Engine Size → Eliminate cars with less than 1600cc.
  - Step 4: Mileage → Eliminate cars with more than 30,000 miles.
  - Step 5: Service History → Eliminate cars without a full-service history.
  - Iterate attributes until there is only one car.

- **Advantages of EBA**:
  - Simple and intuitive—no complex calculations.
  - Reduces cognitive effort by eliminating options step by step.
  - Easy to justify decisions to others.

- **Limitations of EBA**:
  - **Non-compensatory strategy** - a car slightly below one cutoff may be eliminated even if it excels in other areas.
  - **No trade-offs between attributes** - a great price or service history cannot compensate for a minor issue.
  - **Risk of eliminating superior alternatives too early in the process**.



"UNAIDED" DECISIONS

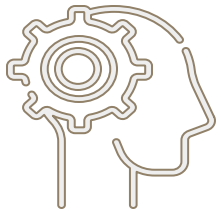
Satisficing

- **How It Works**:
- Unlike previous strategies, satisficing applies when alternatives appear sequentially rather than simultaneously.
- Decision makers stop searching once they find an option that meets their aspiration level—even if better options might exist.

- **Example: Job Search**
- Suppose a person wants a job with:
  - A specific geographical location
  - A minimum salary
  - At least three weeks of paid vacation
- They will accept **the first job offer that meets all these conditions, even if a better job might be available later**.

- **Key Characteristics of Satisficing**:
  - **Aspiration levels shape decisions** — if expectations are too high initially, they may adjust over time.
  - **Order matters** - the final choice depends on the sequence in which options are considered.
  - **Non-compensatory strategy -** no trade-offs between criteria (e.g., salary vs. vacation days).

- **Limitations of Satisficing:**
  - May lead to suboptimal decisions by stopping too early.
  - Changing expectations can cause regret over earlier rejected options.
  - Final choice is highly influenced by the order in which options appear.



"UNAIDED" DECISIONS

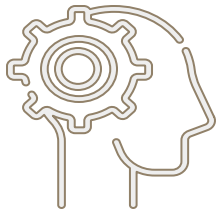
Reason-Based Choice and Decision Framing

- **How It Works**:
- People seek and construct reasons to justify their decisions, instead of a "rational" mindset.
- Impact of Framing: The way a decision is framed influences choices.

- **Example: Hiring Decision**
  - Selection Frame: "Who should be ***selected***?" → Candidate B is preferred for **strong skills**.
  - Rejection Frame: "Who should be ***rejected***?" → Candidate B is still chosen due to **weak attributes**.

Candidate A	**Candidate B**
Average written communication skills	Excellent written communication skills
Satisfactory absenteeism record	Very good absenteeism record
Average computer skills	Excellent computer skills
Reasonable interpersonal skills	Awkward when dealing with others
Average level of numeracy	Poor level of numeracy
Average telephone skills	Poor telephone skills

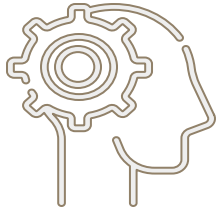
- **Key Insight**: Positive traits matter more in selection, while negative traits matter more in rejection.
- **Violation of Rationality: Decisions should be invariant to framing, but they are not.**



"UNAIDED" DECISIONS

Reason-Based Choice and Decision Framing

- **Inclusion vs. Exclusion in Decision Making**
- **Example: Given a set of *n* candidates, you need to choose a number *s* of candidates to next phase of interviewing.**
- How Decision Makers Narrow Down Choices
  - **Inclusion Strategy**: Selecting candidates to advance → **More thorough evaluation**.
  - **Exclusion Strategy**: Removing candidates from consideration → **More cursory evaluation**.
- **Key Finding:**
  - More options remain when using an exclusion strategy.
  - Inclusion requires more justification, leading to deeper evaluation.
- **Implication**: The way we structure choices influences outcomes.



"UNAIDED" DECISIONS

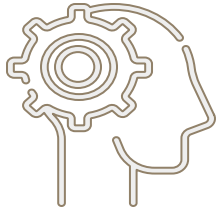
Reason-Based Choice and Decision Framing

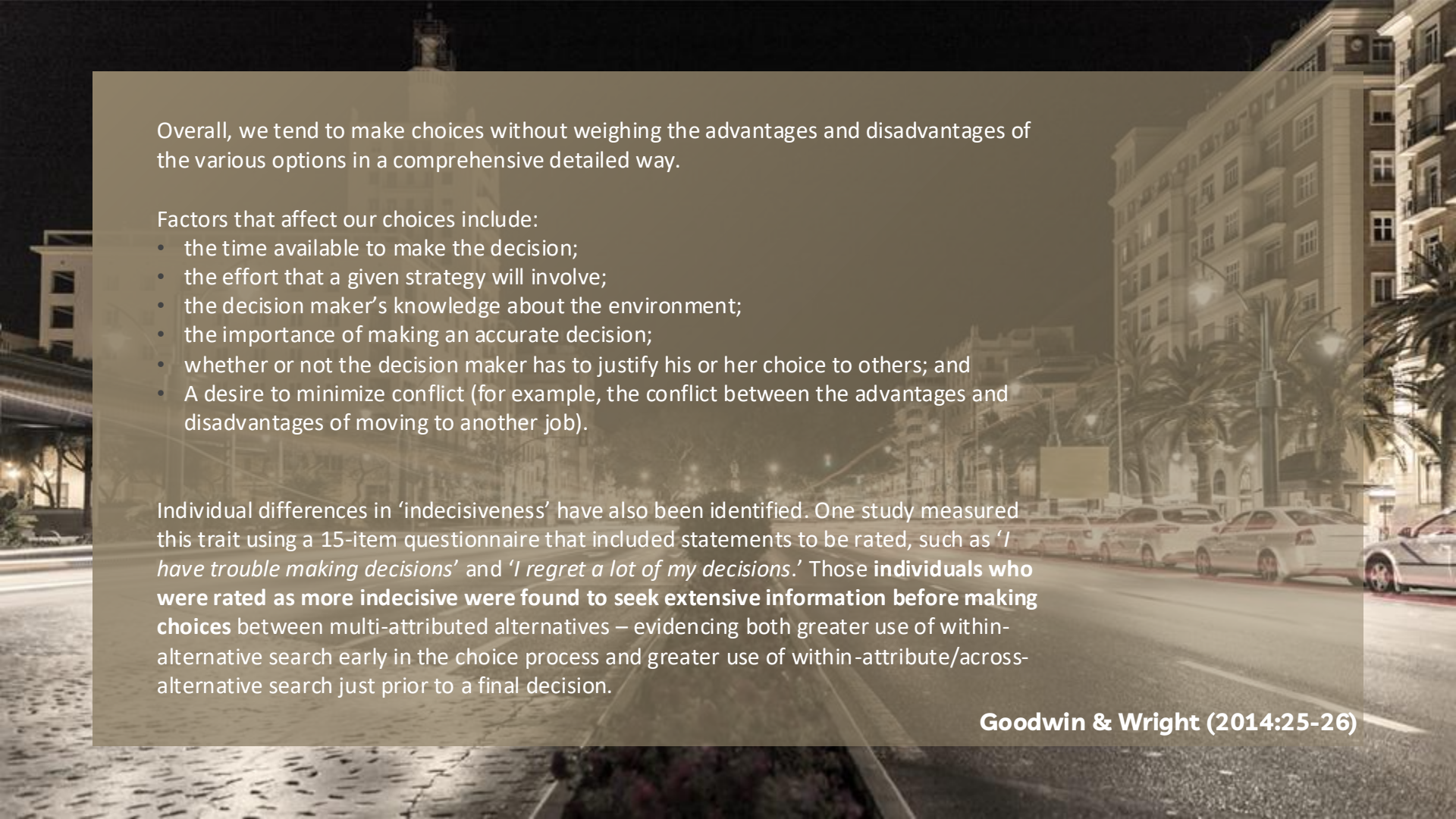
- **Independence of Irrelevant Alternatives**

- **Example 1:**
  - You prefer a holiday in Mexico to a holiday in France.
  - You should still prefer the Mexican to the French holiday even if a third holiday in Canada becomes available

- **Example 2: Buying a Camera**
  - Canon digital camera for sale at a bargain price of $200 in a store that is having a one-day sale.
  - You have the choice between: **(a) buying the camera now** or (**b) waiting until you can learn more about the cameras that are available**.
  - You have no problem in deciding to buy the camera – **you can find a compelling reason to justify this in the camera's remarkably low price**.
  - Option (a) is clearly preferable to option (b).
  - However, once inside the store you discover that a Nikon camera, with more features than the Canon, is also available at a one-off bargain price of $350 (option c).
  - You now have conflict between the cheaper Canon (a) and the more expensive, but sophisticated, Nikon (c).

- **Key Issue**: The new option should not change the original preference, but it does.





Overall, we tend to make choices without weighing the advantages and disadvantages of the various options in a comprehensive detailed way.

Factors that affect our choices include:

- the time available to make the decision;
- the effort that a given strategy will involve;
- the decision maker's knowledge about the environment;
- the importance of making an accurate decision;
- whether or not the decision maker has to justify his or her choice to others; and
- A desire to minimize conflict (for example, the conflict between the advantages and disadvantages of moving to another job).

Individual differences in 'indecisiveness' have also been identified. One study measured this trait using a 15-item questionnaire that included statements to be rated, such as '*I have trouble making decisions*' and '*I regret a lot of my decisions*.' Those **individuals who were rated as more indecisive were found to seek extensive information before making choices** between multi-attributed alternatives – evidencing both greater use of within-alternative search early in the choice process and greater use of within-attribute/across-alternative search just prior to a final decision.

Goodwin & Wright (2014:25-26)

REFERENCES

Today's content was mainly based on

- **Goodwin, P., & Wright, G. (2014). Decision analysis for management judgment. John Wiley & Sons. Chapter 2: How people make decisions involving multiple objectives**
- **Belton, V., & Stewart, T. (2012). Multiple criteria decision analysis: an integrated approach. Springer Science & Business Media. 4.4 Satisfacing and aspiration levels**

THANKS

Does anyone have any questions?
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