

Striving & Doing workshop

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Feelings of effort and feelings of confidence in cognitive
agency

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Outline

1. Introduction: Cognitive agency and metacognitive feelings
2. What is the informational source of metacognitive feelings : effort, or performance?
3. Comparing the predictions from the two main views
4. Conclusion: a double role for effortful control

1. INTRODUCTION

COGNITIVE ACTIONS & METACOGNITIVE FEELINGS

Defining action

- " Behavior is purposive when its course is subject to adjustments which compensate for the effects of forces which would otherwise interfere with the course of behavior."

- *Harry Frankfurt "The problem of action"*



Defining cognitive action

A cognitive action consists in **using compensatory mechanisms** to maintain a trajectory toward a **cognitive (informational) goal**



Examples of cognitive actions

Controlled perception :-
trying to discriminate/
to categorize

Controlled memory
trying to remember, to
learn

Controlled reasoning
trying to solve a
problem, to
understand
an argument,
to plan

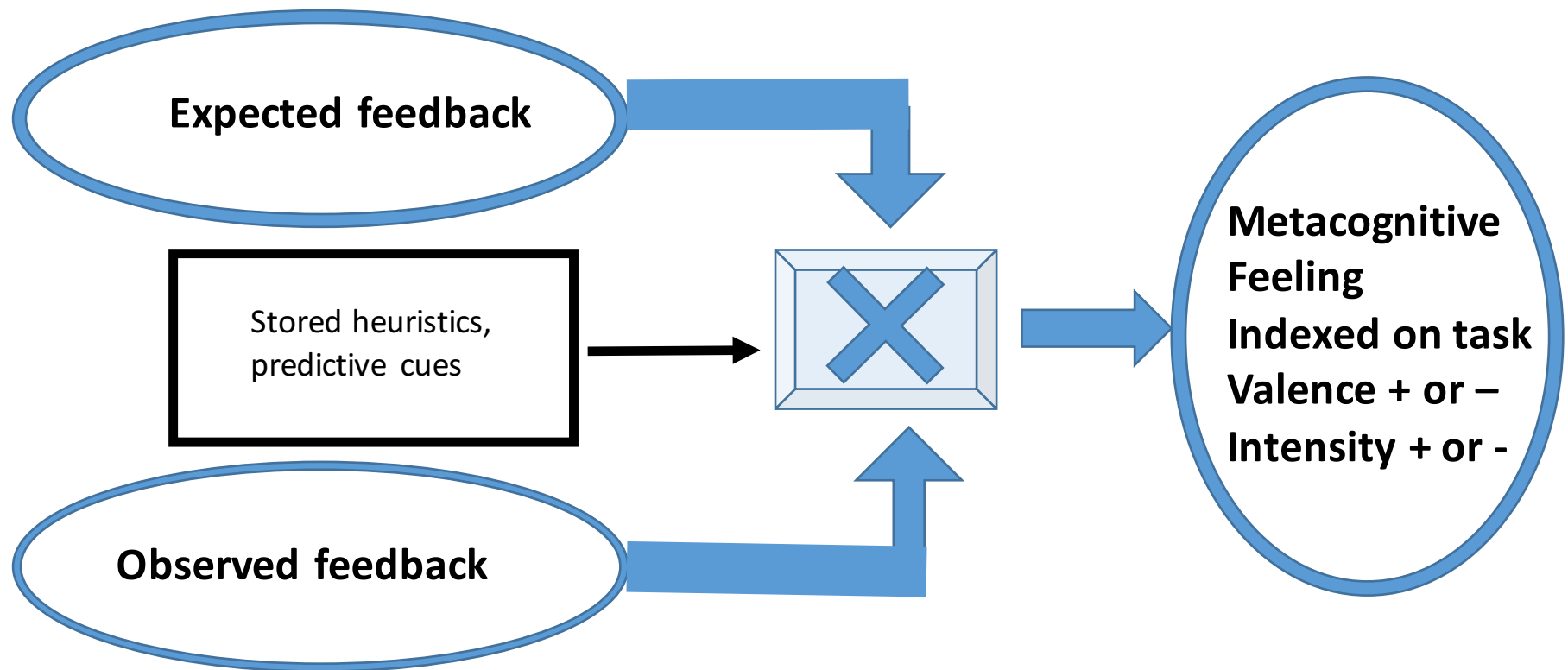
Communicate
trying to
persuade

Controlled imagination
trying to
invent, to
extend one's
thinking

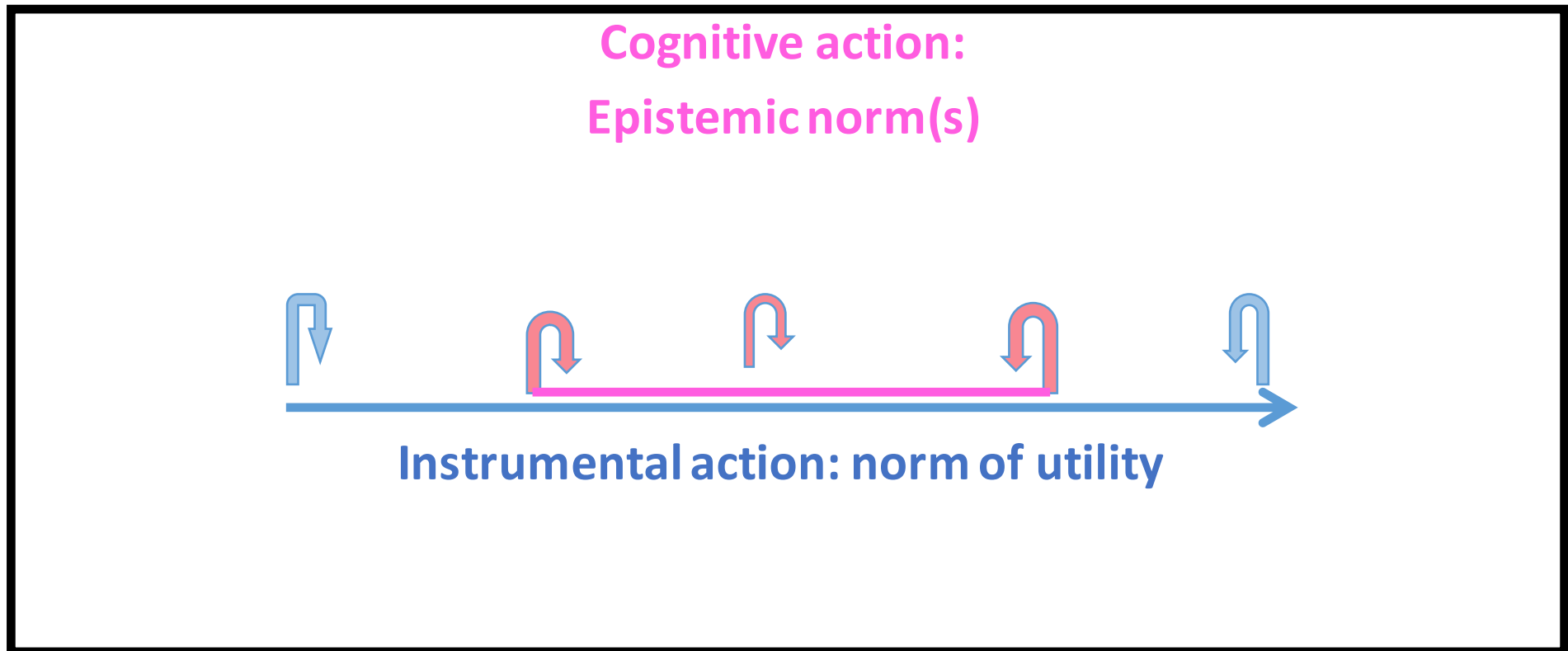
Action feedback (feelings) tracks discrepancies from an expected trajectory

Acting cognitively does not require permanently controlling our train of thoughts, but being prepared to "repair it" if necessary, i.e. when a discrepancy is detected.

At each point of epistemic evaluation, a comparator with the following functional structure



The embedded structure of cognitive action

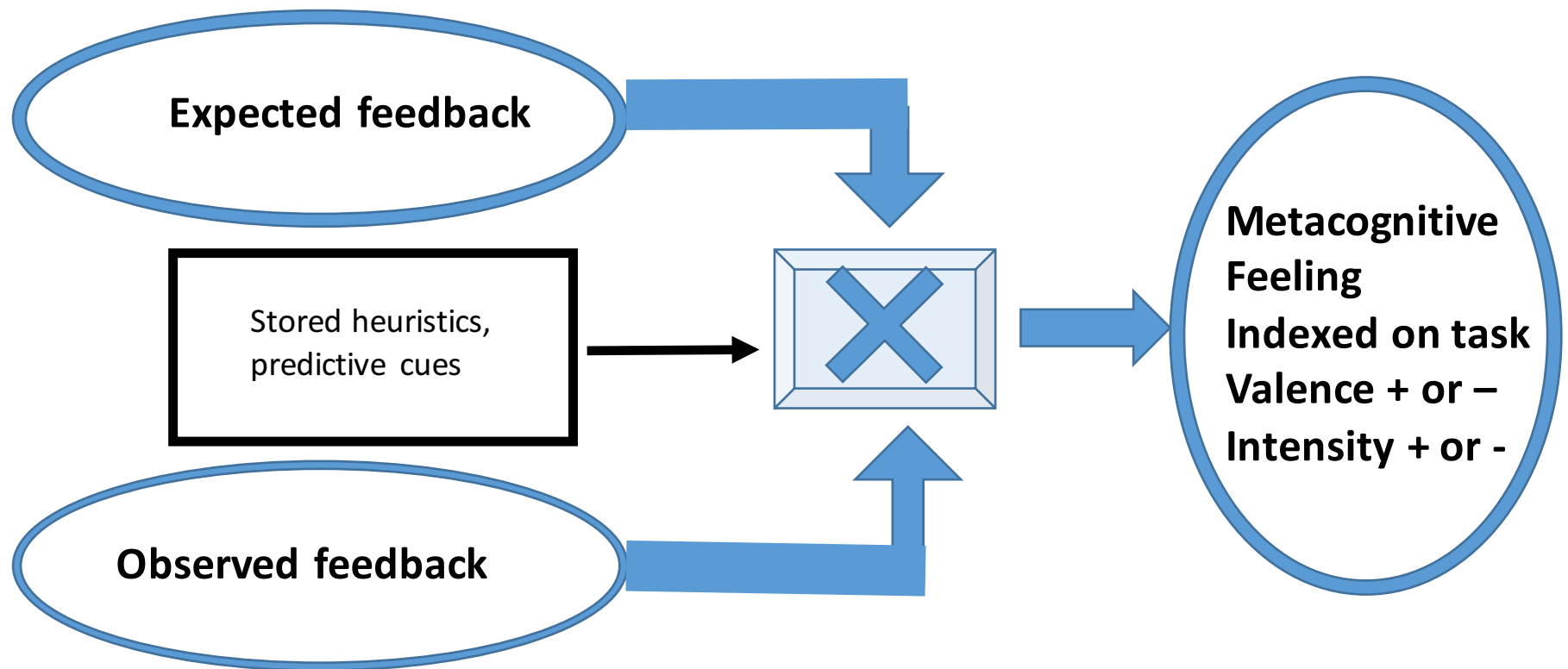


1.2. What is the informational source of metacognitive feelings?

An important controversy in metacognitive studies:
what are the informational sources that drive cognitive
decision-making ?

- **What is the feedback used by the comparators on which evaluations and predictions depend ?**

At each point of epistemic evaluation, a comparator with the following functional structure



Analogy with the bear and the hiker

- **Used by Asher Koriat, Hilit Ma'ayan & Ravit Nussinson, 2006**

When a hiker encounters a bear

James 1890, Koriat, Ma'ayan & Nussinson, 2006



1. Does the hiker run away from the bear because he is afraid ?

- In this case, the faster he runs, the less afraid he is (performance feedback)

2. Or is he afraid because he runs away ?

- In this case, the faster he runs, the more afraid he is ("data-driven feedback from control")

Applied to a cognitive action: how is a judgment of learning formed?



1. Is the agent's metacognitive prediction (ability to remember, solve a problem, perceive, learn etc.) **driven by a noetic feeling** triggered by observed performance?

➤ **In this case, for example, the more time one spends studying an item, the more confident one is to have learned it (performance feedback")**

Applied to a cognitive action: how is a judgment of learning formed?



2. Or is the agent's metacognitive prediction driven by the sensed effort invested in the activity ?

➤ **In this case, the more effortful a task feels, the less likely it seems to be correctly performed ("data-driven feedback from control operations")**

Koriat and coll's response in a nutshell

Proposal 1 (the view that one's perception of the effort invested in the activity should **increase one's confidence in learning** or problem solving)

- is backed up by a naive belief about one's own cognitive functioning
- Things are much more complicated : the relationships between monitoring and control and "intricate".
- Proposal 2 is more compatible with evidence.

3. Comparing predictions from views 1 and 2

An experimental task

- Designed to test the basic hypotheses of view 2 (the monitoring model of memorizing effort) :
 1. learners use memorizing effort (study time) as a predictive cue for learning: end of study JOLs are **inversely related** to study time.
 2. Memorizing effort is a valid predictor of long-term recall (study time **is inversely correlated with recall**)

Predictions from the Classical view: Performance monitoring drives strategic control

Discrepancy reduction model (Dunlosky & Hertzog, 1998)

1. because study time (effort) is determined by the perceived discrepancy between observed learning and stored learning norm during performance, **JOLs should increase** with study time
2. Memorizing effort is a valid predictor of long-term recall : study time **is directly correlated with recall**

The task

- Participants have to study 60 Hebrew word pairs with different associative strengths (more or less difficult to memorize).
- They can use as much time as they want to study (or not)
- They produce a judgment of learning after having learned a given pair :

chances to recall (0%-100%) ?

- Participants' memory is tested by a cued recall test

Various conditions

- Contrast between a **self-paced and a fixed rate condition** (yoking fixed rate participants to one self-paced participant to that the mean study time spend on each item was the same).
- JOLs collected **immediately after study or some time after**
- **Paired associated can be presented four times** to self-paced and fixed rate yoked participants and JOLs collected at the end of each study block (to test improved accuracy of JOL)
- **Differential incentive** : half of items receive a 1 point bonus, half 3 points (to manipulate effort in its control and in its monitoring function) versus **Constant incentive** : all items awarded 2 points.

Results incompatible with theory 1

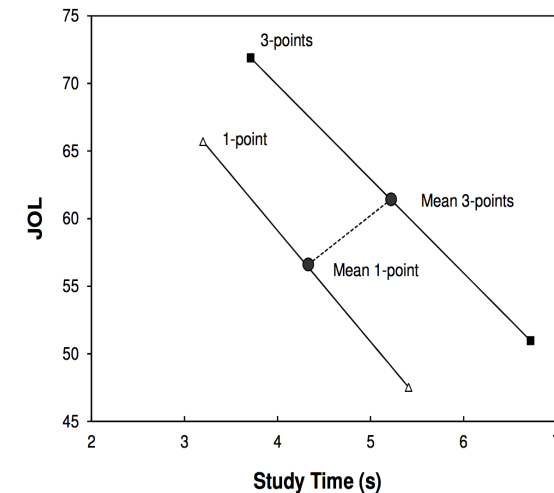
- **An inverse relationship between JOLs and study time** is obtained both by self-paced and fixed rate participants.
- **Recall performance also decreased in both groups with study time**
- JOLs are not about the same for easy and difficult items in self-paced participants, **which shows that they did not try to reduce the discrepancy with a stored norm of study**
 - This suggests that JOLs are indeed based on study time rather than on perceived discrepancy.

Incentives

- Participants **allocate more or less effort to learning** as a function of incentives, which modulates their **performance**
- But their JOLs are only proportionally increased by their added effort

The role of expected reward

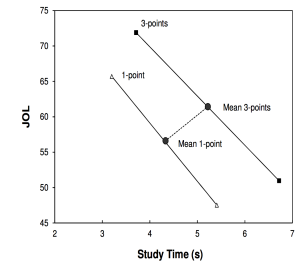
- The **relative calibration of confidence** is unaffected by the level of effort involved.
- In spite of the diversity in reward, one continues to be **more confident** in one's learning in the trials that required the least amount of time to complete *within a given reward category*.



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The real experiment: the role of expected reward

- The negative impact of learning duration and the positive impact of the expected reward combine in the feeling of confidence expressed by the learning judgment, *without merging*.



Conclusion

A double role for control

- **control selection** (how fast the hiker runs away) : **the brain selects a level of effort** as a function of expected rewards and risks (OBJECTIVE EFFORT).
- **control monitoring** (how well the hiker *thinks* he is doing): PERCEIVED EFFORT **negatively** impacts feelings of confidence.
 - Control monitoring tends to be **accurate** – predict performance

How to reconcile theories 1 and 2

- **The function** of metacognitive feelings is to guide goal-oriented control. (as claimed by theory 1)
- **The basis** of metacognitive feelings, however, consists in **nonanalytic heuristics that operate unconsciously**:
 - "The system engages in a self-reflective **inspection of its own operation (not of its observed external outcome)** and uses the ensuing information as a basis for metacognitive judgments" (Koriat & Levy-Sadot 1999).

Even "classical" noetic feelings are mainly based on control

- **Processing fluency is a dimension of control operations (such as trying to remember, trying to perceive, etc., with no consideration for contents.**
- **Notice the similarity between :**
 - Determining the weight of an object **by lifting it** (from sensed effort to object properties)
 - Determining whether one knows a name **by attempting to retrieve it** (Feeling of Knowing)
- **Hence, concepts are not required to guide cognitive evaluations such as confidence (even though they can, and have a considerable role in strategic thinking).**

Harry Frankfurt
Ravit Nussinson (Levy-Sadot)
Asher Koriat



Thanks for your attention !

Papers and presentations up for download:
<http://joelleproust.org>