unconscious knowledge and inference

Zoltan Dienes

University of Sussex

1. Distinguishing conscious from unconscious knowledge

2. Distinguishing structural and judgment knowledge

3. Why is some knowledge conscious?

Part I: Distinguishing conscious from unconscious states: Higher order state theory

(e.g. Carruthers, 2002; Rosenthal, 2005):

1. A conscious mental state is a mental state of which we are conscious

Higher order state theory

(e.g. Carruthers, 2002; Rosenthal, 2005):

1. A conscious mental state is a mental state of which we are conscious

2. We are conscious of things, states, etc by thinking or perceiving that they exist

Higher order state theory

(e.g. Carruthers, 2002; Rosenthal, 2005):

1. A conscious mental state is a mental state of which we are conscious

2. We are conscious of things, states, etc by thinking or perceiving that they exist

=> A mental state is conscious when we think (or perceive) we are in that state

Higher order thought theory

(e.g. Carruthers, 2002; Rosenthal, 2005):

A mental state is conscious when we think we are in that state

e.g. Seeing is conscious seeing when I think I am seeing

If I see but don't represent I am seeing, it is unconscious

For example,

Representing “an object is moving up”

Is seeing but not conscious seeing

For example,

Representing “an object is moving up”

Is seeing but not conscious seeing

Representing “I see that an object is moving up”

is a higher order thought (HOT) - conscious seeing.

For example,
Representing “an object is moving up”
Is seeing but not conscious seeing

Representing “I see that an object is moving up”
is a higher order thought (HOT) - conscious seeing.

Any method for assessing the conscious or unconscious status of knowledge does its job only to the extent it plausibly assesses the presence of relevant HOTs

The appropriate measure of the unconscious status of knowledge states is one that determines if the subject has an appropriate Higher Order Thought (HOT) about being in the knowledge state he is in fact in.

The appropriate measure of the unconscious status of knowledge states is one that determines if the subject has an appropriate HOT about being in the knowledge state he is in fact in.

Two criteria for measuring implicit knowledge (Dienes & Berry, 1997):

Guessing criterion
When subjects believe they are literally guessing, is their performance above chance?

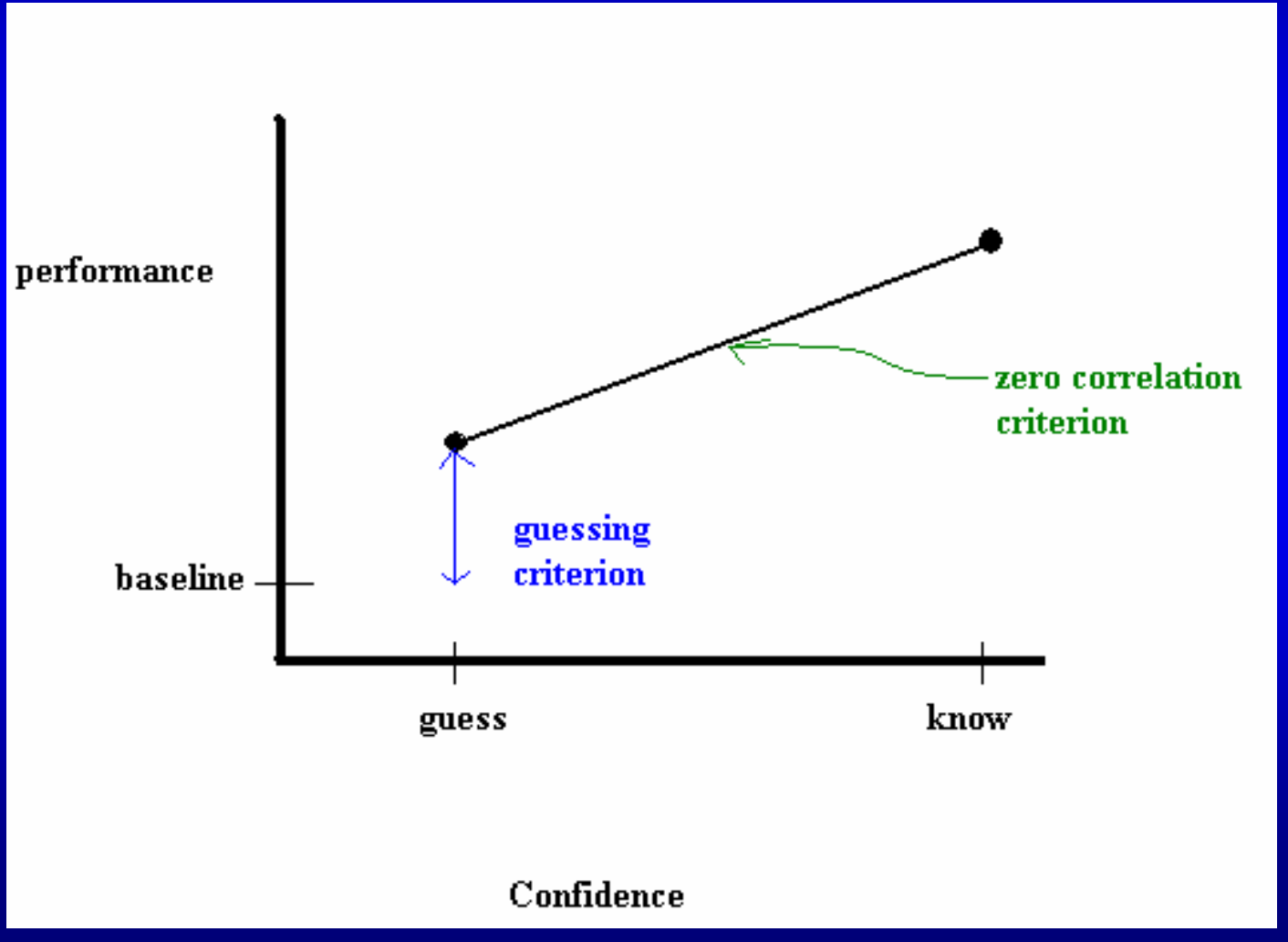
The appropriate measure of the unconscious status of knowledge states is one that determines if the subject has an appropriate HOT about being in the knowledge state he is in fact in.

Two criteria for measuring implicit knowledge (Dienes & Berry, 1997):

Guessing criterion
When subjects believe they are literally guessing, is their performance above chance?

Zero-correlation criterion
Is their a lack of relationship between confidence and accuracy?
Do subjects fail to discriminate between guessing and knowing?

The most direct way of testing for conscious knowledge is to test for higher order thoughts.

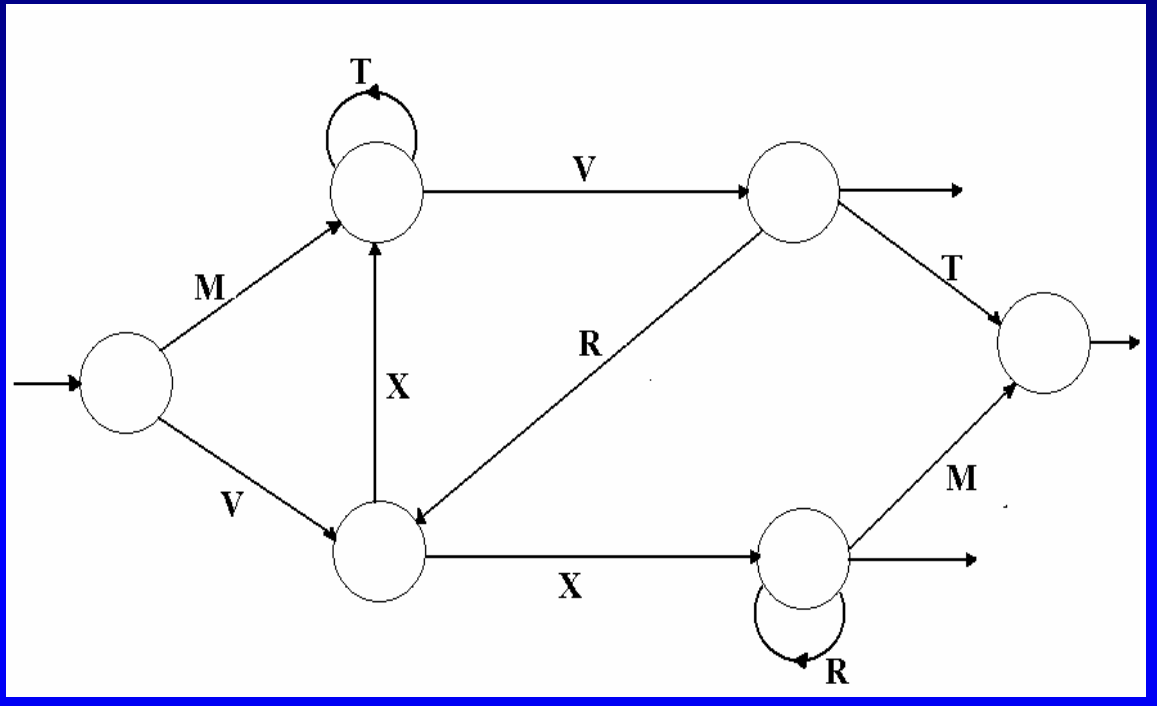


Implicit learning:

Acquiring knowledge one does not know one has

E.g. show people strings of apparently randomly ordered letters.

MTTTTV	**MVRX**
VXRR	**VXTVRX**
MTTVT	**VXM**
MTVRX	**MTV**
MVRXVT	**MVRXRR**



An example of a finite state grammar used for generating stimuli in artificial grammar learning experiments

People can classify new test strings even though they find it difficult to say what the rules are.

How can we tell whether the knowledge is really unconscious?

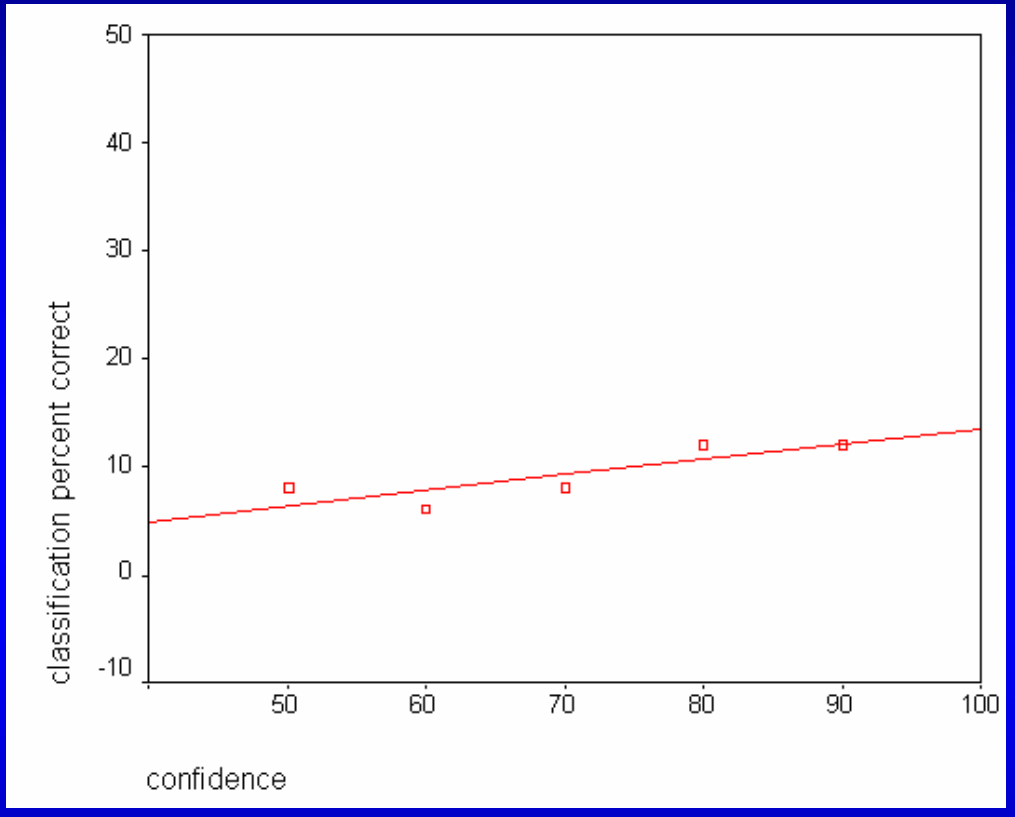
Take confidence ratings in the test phase and apply guessing and zero correlation criteria.

Typically, confidence ratings are given on a 50-100 scale where

50 = literal guess, expected performance is 50%

100 = complete certainty, expected performance is 100%

Dienes, Altmann, Kwan, & Goode(1995). Advantage of trained group over untrained baseline:



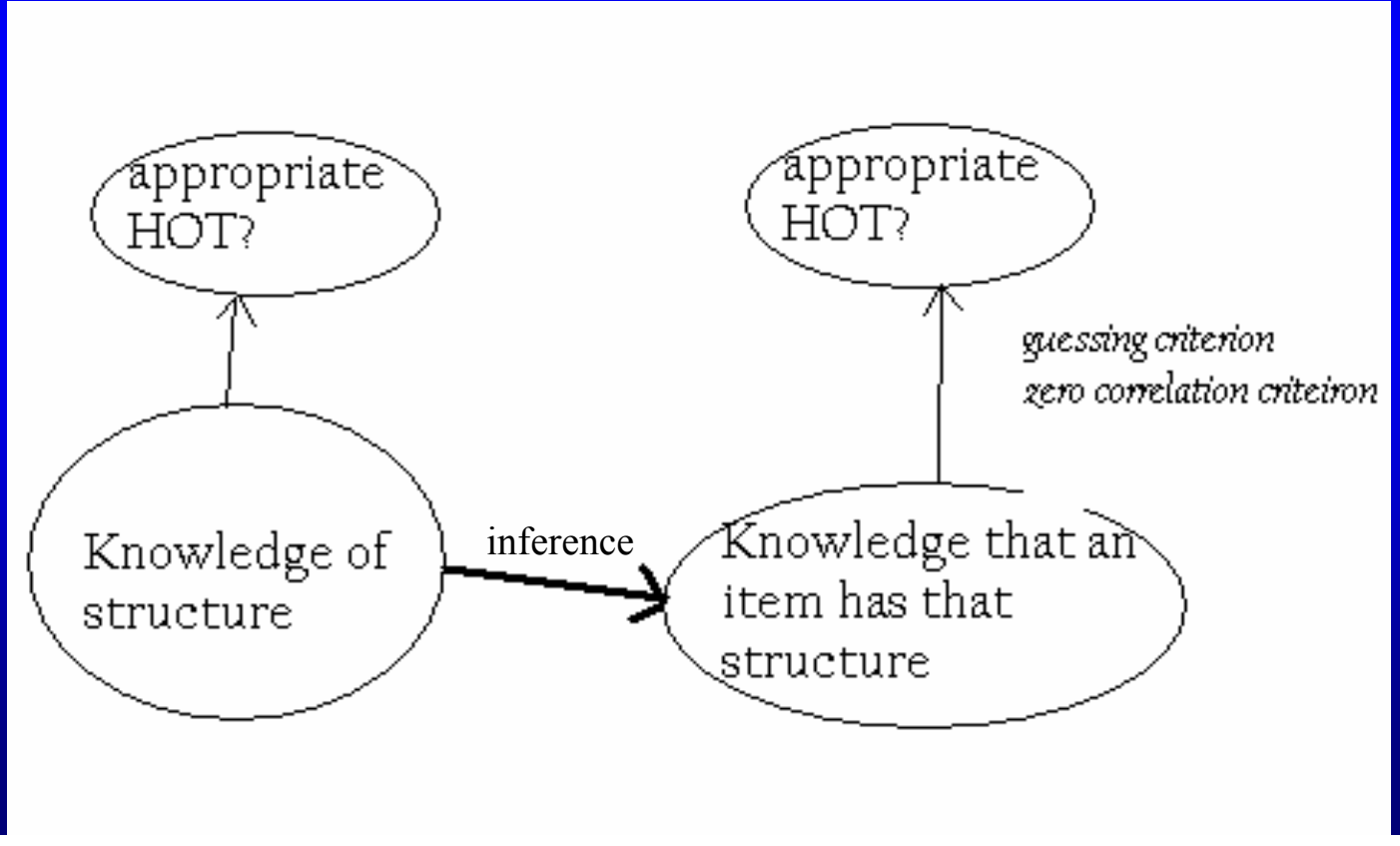
Intercept above 0 => some unconscious knowledge

Slope > 0 => some conscious knowledge

Part II: Structural vs judgment knowledge

Training phase -> knowledge of structure of training items (structural knowledge)

Test phase -> knowledge that an item does or does not have that structure (judgment knowledge)



Presumably, conscious structural knowledge leads to conscious judgment knowledge

But if structural knowledge is unconscious, judgment knowledge could be conscious or unconscious.

Consider natural language: If shown a sentence one can know it is grammatical and consciously know that it is grammatical, but not know at all why it is grammatical

If both structural knowledge and judgment knowledge unconscious => phenomenology is of guessing

If structural knowledge unconscious but judgment knowledge conscious => phenomenology is of intuition (cf natural language)

In both cases, we have unconscious structural knowledge.

But in second case, zero correlation and guessing criteria might show all knowledge is conscious – because those criteria only assess judgment knowledge

Dienes and Scott (2005)

In test phase, subjects rated confidence in judgment and rated the basis of the judgment:

1. **Guess** – judgment has no basis whatsoever, may as well have flipped a coin
2. **Intuition** – have some confidence in judgment, but have no idea why it's right
3. **Pre-existing knowledge** – judgment based on knowledge I had before the training phase
4. **Rules** – judgment based on rules acquired from the training phase I could state
5. **Memory** – judgment based on memory for training strings or parts of training strings

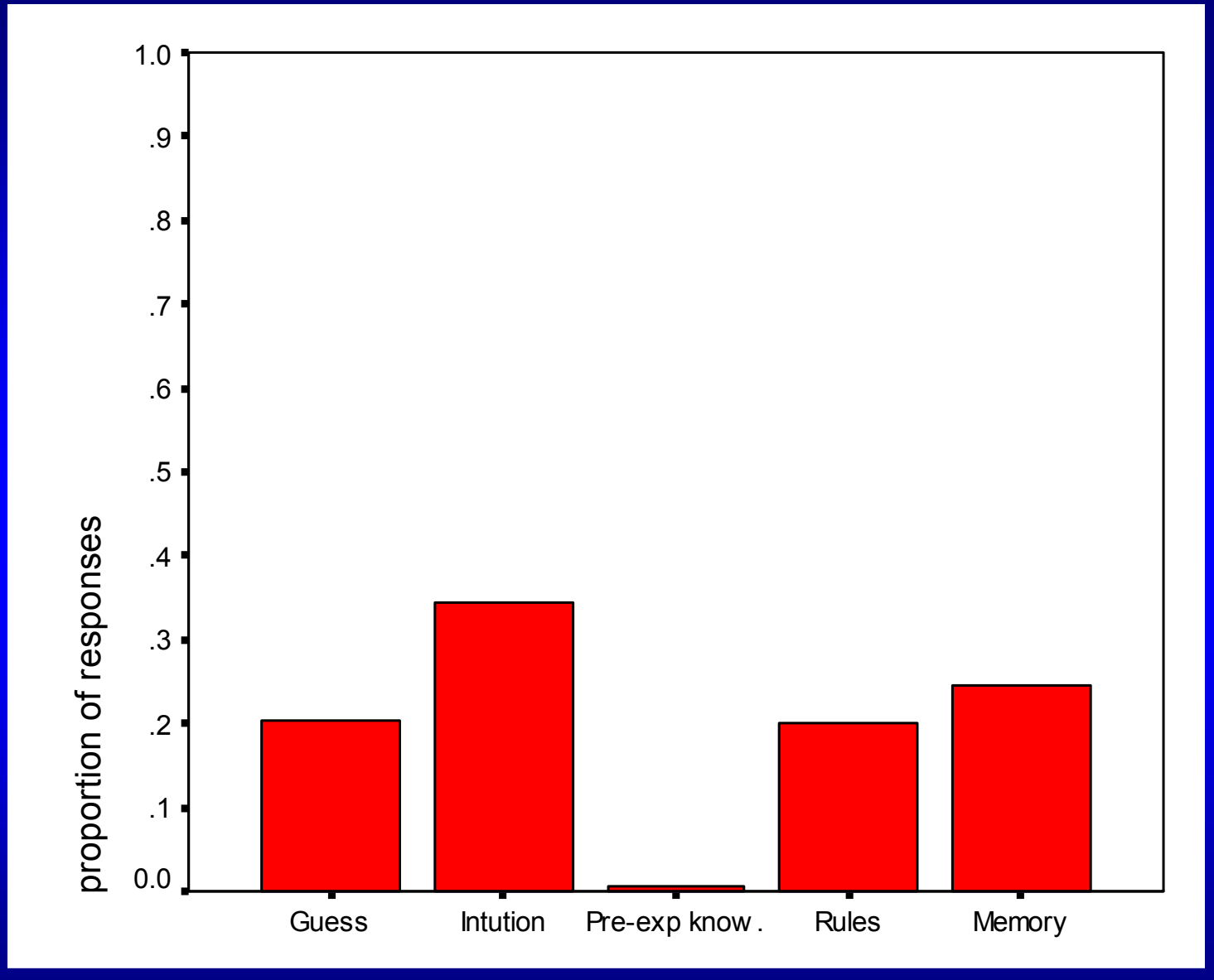
Independent variables:

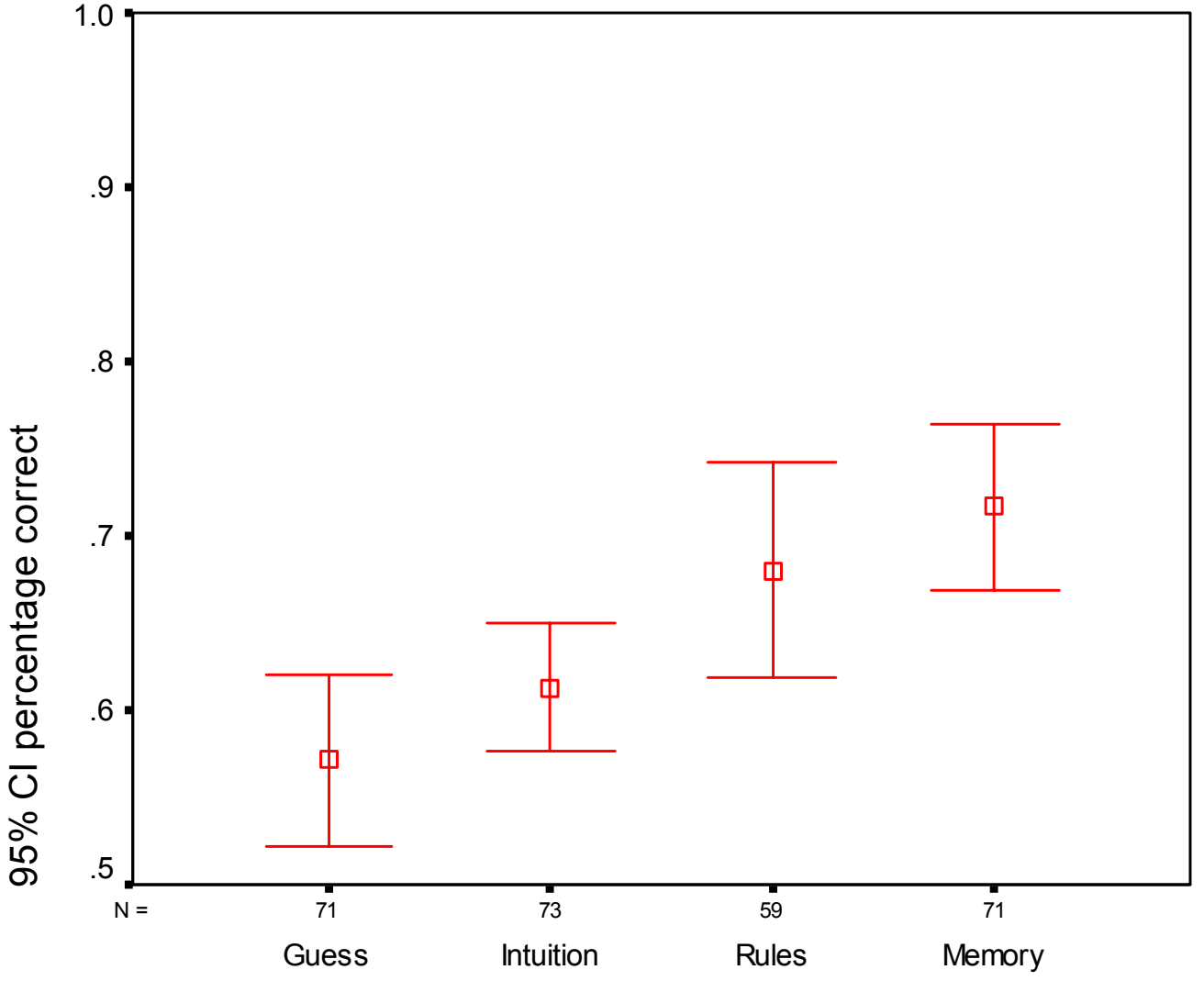
1. In the training phase, urged to search for rules or just memorize exemplars.

   Rule search should encourage the development of conscious structural knowledge.

2. In the test phase, classify with full attention or while performing a demanding secondary task (random number generation).

   Secondary task should interfere with the application of conscious structural knowledge.

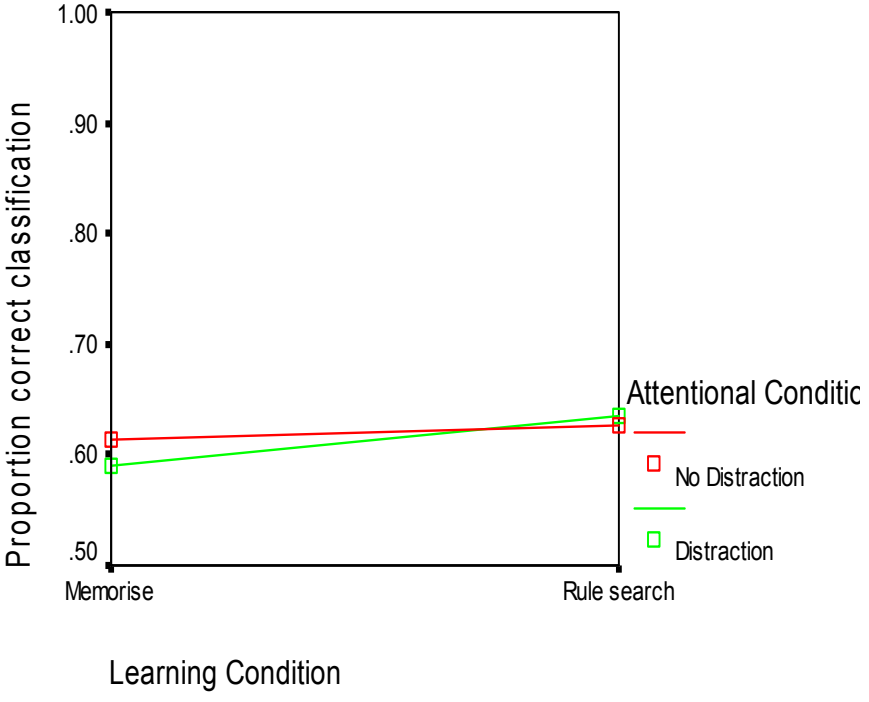

1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
0.0
proportion of responses
Guess
Intution
Pre-exp know .
Rules
Memory



NB: proportion correct significantly above .50 for each basis

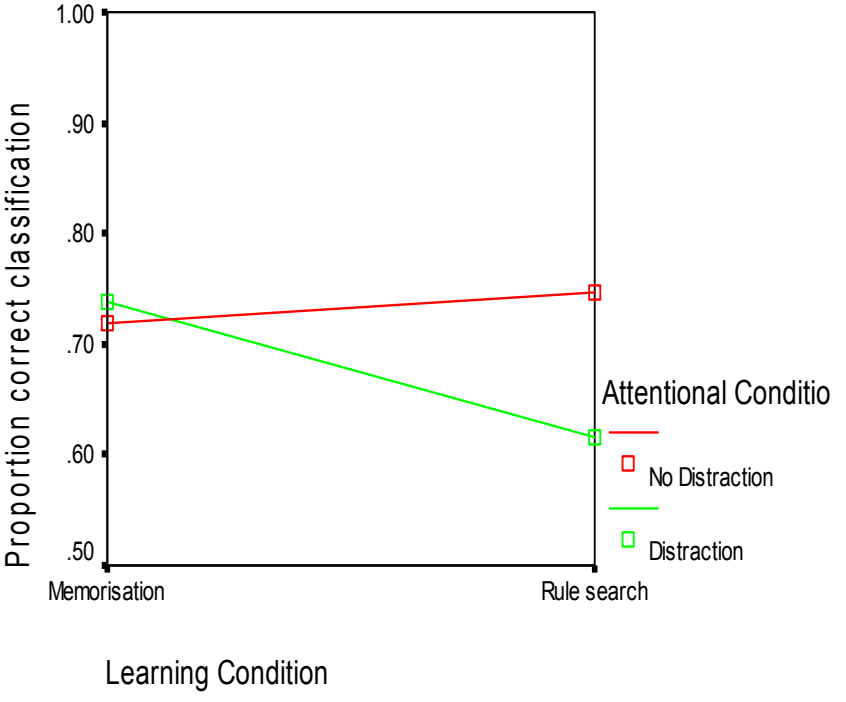
Implicit basis

(Guess plus intuition)



Explicit basis

(Rules + memory)



When there was an implicit basis: No effect of learning condition nor secondary task on percentage correct

When there was an explicit basis: A secondary task disrupted correct classification in the rule search condition

Interim summary:

The conscious status of judgment knowledge, and its basis, structural knowledge, can be assessed independently.

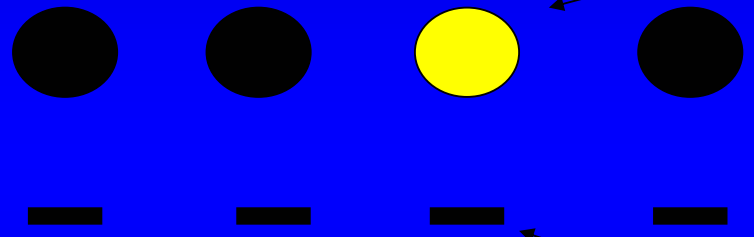
Unconscious structural knowledge can produce both conscious and unconscious judgment knowledge.

The conscious/unconscious status of structural knowledge sensitively reflects the effects of learning mode and secondary task.

Structural and judgment knowledge in the

Serial reaction time task

(Nissen & Bullemer, 1987)



On each trial a light goes on

Just press corresponding button

Unbeknownst to subject, sequence of lights is rule governed

Fu, Fu, and Dienes (submitted)

Training: 75% of time sequence A is followed, 25% of time sequence B

(vice versa for half the subjects)

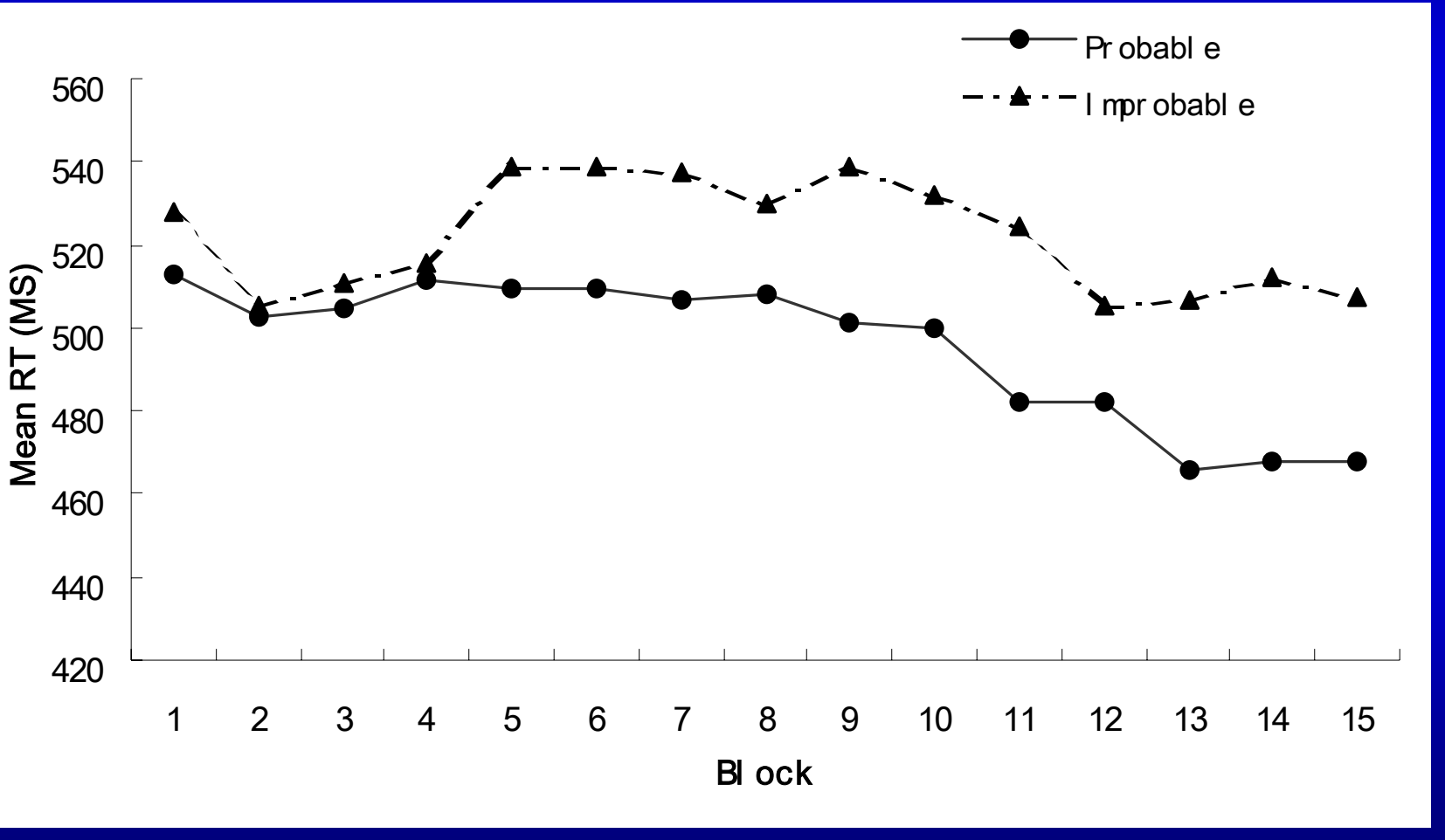
Afterwards subjects were told that the sequence was structured

subjects were asked to generate a sequence:

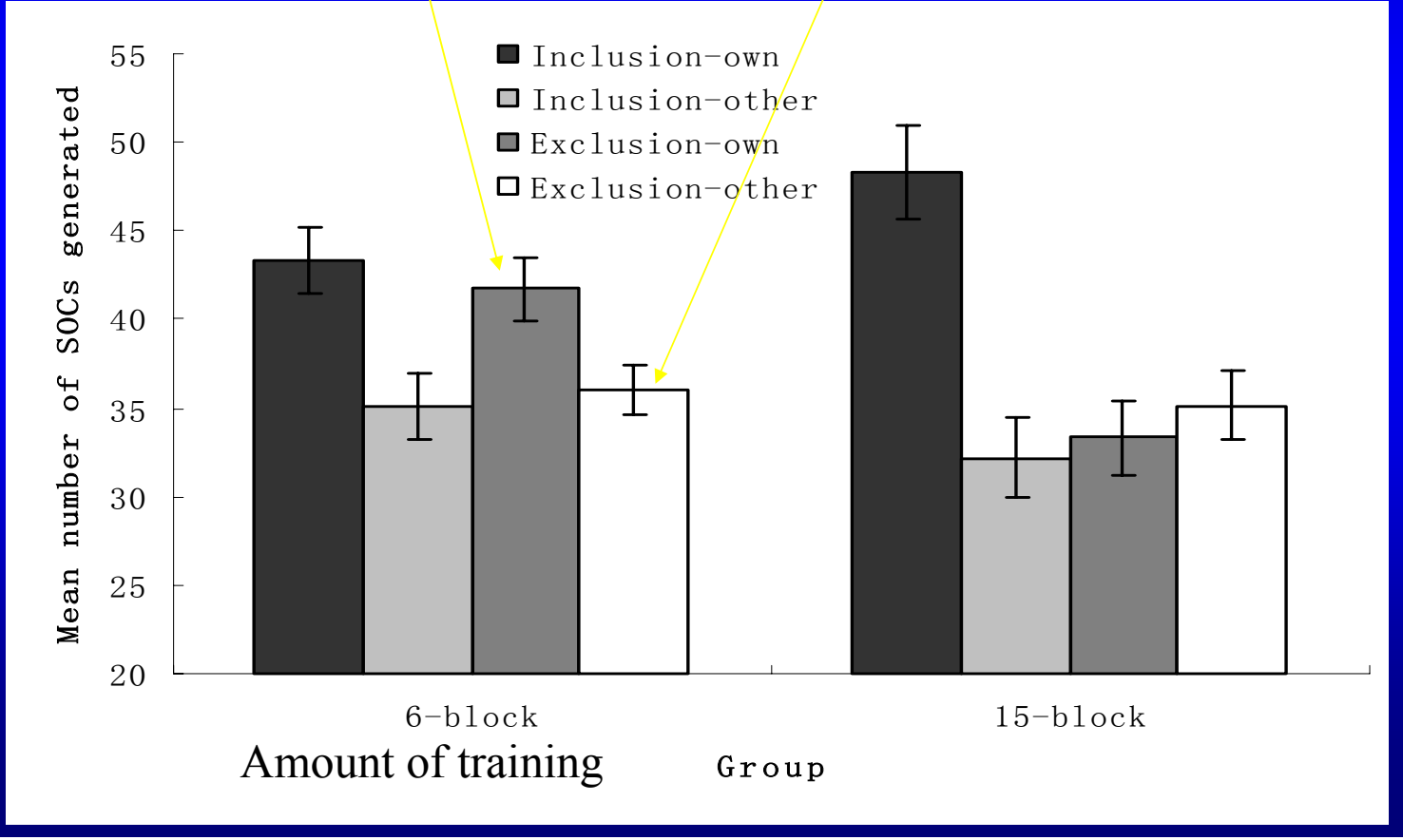
The same as they the one they just had (inclusion)

Different to the one they just had (exclusion)

Training


Probable
Improbable
560
540
520
500
480
460
440
420
Mean RT (MS)
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Block

When subjects were trying to NOT produce their sequence, in fact they produced more chunks from their own sequence than the other one



Early in training subjects still generated responses that followed the rules! (exclusion significantly above baseline)

Why might this happen?

Early in training subjects still generated responses that followed the rules! (exclusion significantly above baseline)

Why might this happen?

Subjects think of a response – their structural knowledge will tend to make them think of legal responses

Early in training subjects still generated responses that followed the rules! (exclusion significantly above baseline)

Why might this happen?

Subjects think of a response – their structural knowledge will tend to make them think of legal responses

If they feel they are sure the response is legal they withhold that response;

If they feel they are guessing about whether it is legal or not (they don't know that they know) they press the key for that response.

Early in training subjects still generated responses that followed the rules! (exclusion significantly above baseline)

Why might this happen?

Subjects think of a response – their structural knowledge will tend to make them think of legal responses

If they feel they are sure the response is legal they withhold that response;

If they feel they are guessing about whether it is legal or not (they don't know that they know) they press the key for that response.

Hence this task relies on a subject's assessment of his mental state – it is a disguised subjective measure!

A test of the conscious status of judgment knowledge. What about structural knowledge?

After training subjects shown two trials and had to say

What could come next (**inclusion**)

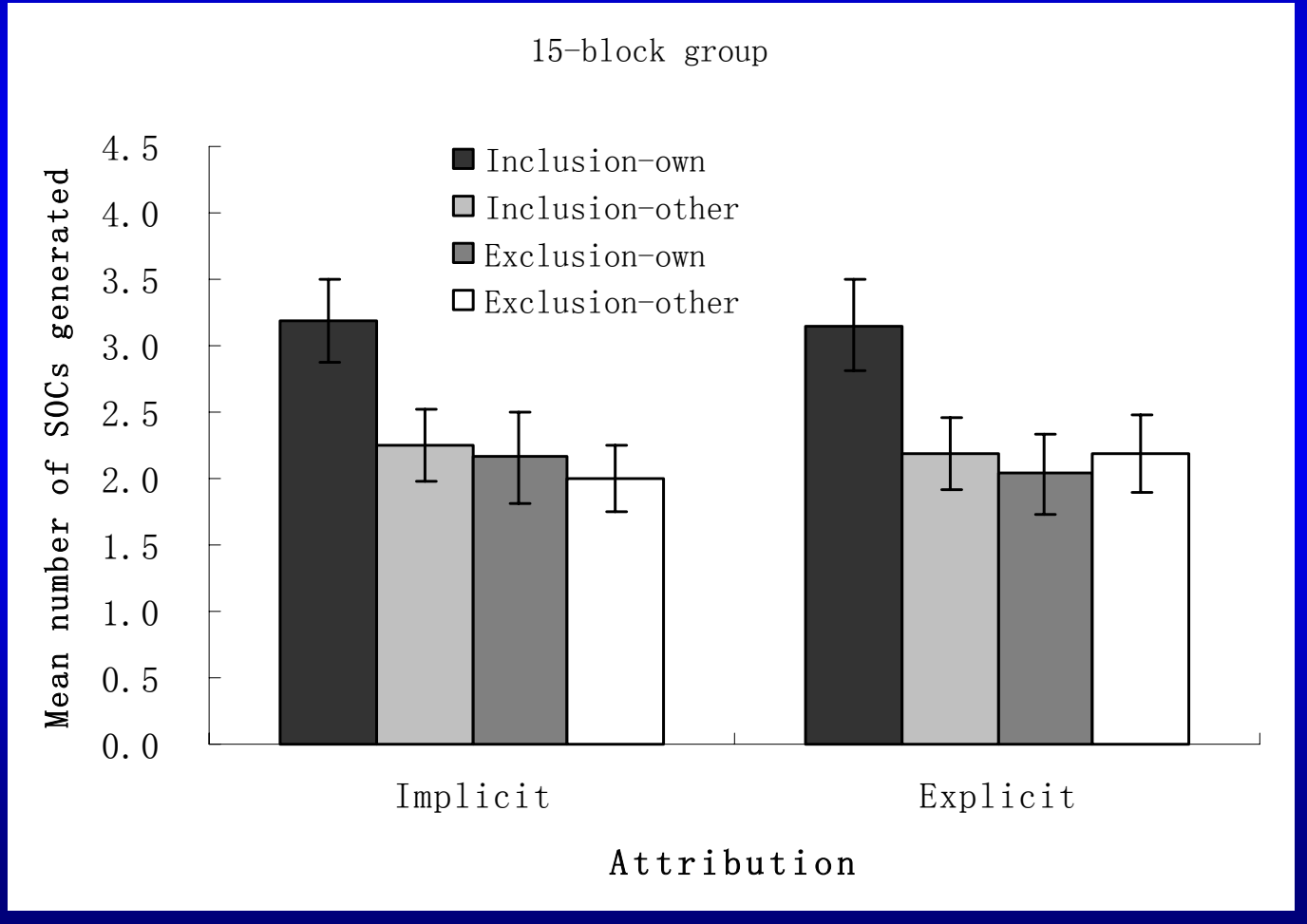
What couldn’t come next (**exclusion**)

Give a structural knowledge judgment

Test.

Own = answer from own sequence; other = from other sequence

Implicit = guess + intuition, explicit = rules + memory



Interim summary:

SRT task is based on both conscious and unconscious structural knowledge

And gives rise to both conscious and unconscious judgment knowledge

Conclusions:

1. It is useful to distinguish structural and judgment knowledge and the conscious and unconscious status of each. There are plausible methods for doing this.

2 . Unconscious structural knowledge can produce both conscious and unconscious judgement knowledge

=>unconscious inferences can produce both conscious and unconscious knowledge

Part III: Why is some knowledge conscious?

Why is some knowledge conscious and other knowledge not?

What is gained by a knowledge state being conscious?

Conscious knowledge can be used to overcome habits – conscious knowledge came about to allow executive abilities?

Higher order thought theory applies to intentions:

First order mental state:

"**Lift the arm**!"

This is unconscious unless you are aware of having that intention by a second order thought:

"**I intend to lift my arm**"

Consequence: HOT theory predicts that (*pace* Norman & Shallice, Jacoby) executive tasks (tasks requiring intentions) can be performed unconsciously

Cold control theory of hypnosis (Dienes & Perner, forthcoming)**:**

Successful response to hypnotic suggestions can be achieved by forming an intention (imperative representation in the executive system) to perform the action or cognitive activity required, without forming the higher order thoughts about intending that action that would normally accompany the reflective performance of the action.

Can hypnotic suggestions involve executive function tasks?

a) Suggestion to forget the number "four": "1,2,3,5,6,.." - must be content control, but person claims ignorance of doing anything strange => no second order thought.

b) Spanos, Radtke, and Dubreuil (1982): highs suggested to forget certain words in any type of task given to them produced those words at a below baseline level in a word association test. Executive control because existing associations must be suppressed.

c) Amazingly: Raz et al (2002, 2003): Highs can eliminate the Stroop effect when it is suggested the words are meaningless (can occur in or out of hypnosis)

In general, virtually any arbitrary behaviour can be hypnotically suggested despite the fact that such behaviour might be novel to the person, and many hypnotic suggestions require the person ignore some salient aspect of the situation (e.g. amnesia or analgesia suggestion)

=> many hypnotic responses are under executive control.

=> Executive functioning (System II) need not be performed consciously! (But normally is.)