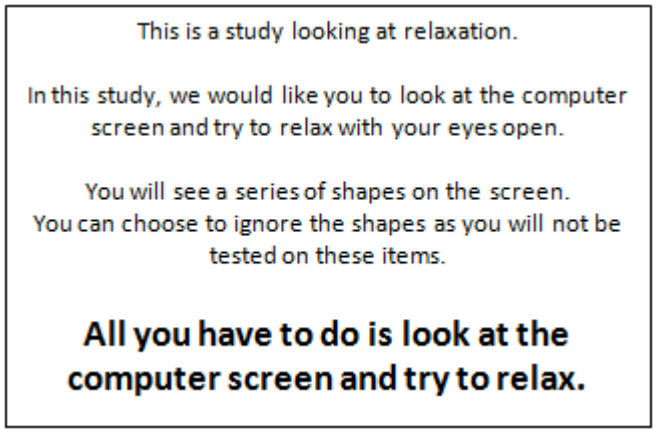
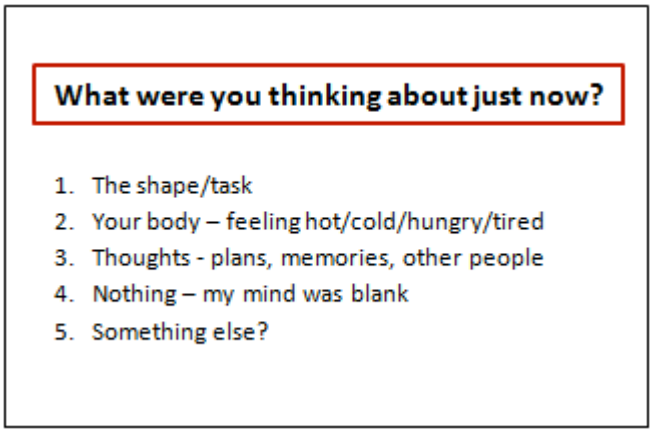
"Shape Expectations" thought sampling task – Administration guidelines

1. Prior to commencing the task, participants are informed that they will be undertaking a study that primarily requires them to relax and focus on shapes presented on a computer screen. The following instructions are presented to the participant and any questions regarding the task demands are answered:



2. Participants are reassured that they do not need to remember the shapes presented, and that all they need to do is look at the screen and relax. A practice trial is then provided to familiarise participants with the task.

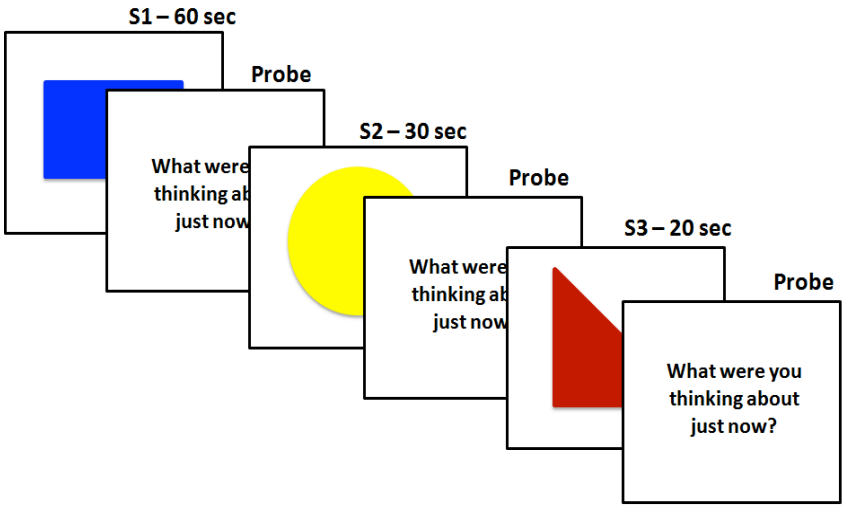
3. A practice trial consisting of a red quadrilateral shape shown on screen for a duration of 60 seconds is then presented. Immediately after the practice shape, the following Slide is shown:



Participants are asked to report what they were thinking during the time the shape had been presented on the screen. The experimenter should encourage the participant to fully report what they had been thinking about during the presentation phase, via undirected probes such as "Were you thinking about anything else during that time? Can you remember any other thoughts that you had when looking at that shape?" The experimenter should assure the participant that there is no right or wrong answer and then describe other possible responses that individuals may think

about during the task including; 1) Thinking about the shape or the task; 2) Thinking about their bodily sensations (i.e. feeling hot/cold/tired/hungry); 3) Making future plans or reminiscing about something; or 4) Thinking about nothing at all and their mind was blank.

4. Once the participants indicate that they understand the task demands, the experimenter then explains that they will complete a number of trials which range in duration. The experimental trials are then administered, during which time, the experimenter sits behind the participant so as not to unduly distract them. The experimenter notes all instances of external distractions (e.g., noise on corridor, doors slamming, traffic outside) and also records any signs of the participant directing their attention away from the screen. In such instances, the experimenter must reorient the participant to the screen and record the behaviour.



General administration points:

- The participant’s responses must be recorded verbatim on the score sheet provided.
- All external distractions and participant behaviours must be recorded throughout the stimulus presentation phases. It is essential that testing takes place in a quiet, distraction-free environment.

- Participants must be allowed ample time to verbalise their responses, with the experimenter only moving on once the participant is satisfied that they have reported all of their thoughts during a given trial.

- General prompts are permitted by the experimenter to elicit further details from participants, for example, “Were you thinking about anything else during that time? Can you remember any other thoughts that you had when looking at that shape? Is that everything that you were thinking about during that trial?” It is strictly forbidden for the experimenter to introduce any new concept

or idea, or to direct the participant in a manner that could influence the content of their thoughts.

- The experimenter must discourage the participant from talking or asking questions during the trials. The participant must be reminded that they are required to focus their attention on the shapes.

“Shape Expectations” thought sampling task - Scoring guidelines

Section one: Overall performance

Participants’ responses on each trial are assigned a score along a continuum ranging from 1-4 points, which classifies the extent to which their thoughts are stimulus bound or represent pure instances of mind wandering.

As the experiment consists of 9 trials, the total performance score therefore ranges from 9-36 points.

Thoughts are classified according to the following criteria:

1 point = Nothing / Labelling what is on the screen
A score of 1 suggests that the individual has not generated any specific thoughts during the presentation of the stimulus. The absence of internally generated thought is typically reflected by a response of “nothing”, or “my mind was blank.”

A score of 1 point is also assigned to thoughts that are completely stimulus-bound. Typical responses for this category include merely labelling the shape presented on the computer screen, for example “It’s just a yellow circle, nothing else.”

2 points = Stimulus- / task- / environmental- dependent responses
Responses scoring a 2 reflect thoughts that are heavily dependent on the stimulus attributes, task features, or other environmental factors. In level 2 responses, the individual has moved beyond merely labelling what is on the screen or describing thinking of “nothing”, however the response still relates very directly to Stimulus- / task- / environmental factors. Examples of level 2 responses include:

- Responses highly related to the particular *stimulus*, including attributes of the stimulus such as shape, colour, duration (e.g., “That’s a nice round shape”; “Yellow is my favourite colour”; “This one’s taking a long time”).

- Responses related to the *task* itself, including task-related interferences (TRIs) relating to appraisal of the task or to the purpose of the task (e.g., “What’s the point of this task”; “I wonder if the shapes have any significance”; “This task is boring”).

- Responses related to *environmental* or *sensory* distractions (e.g. “I can hear the birds outside”; “It’s cold in here”; “I was thinking about how hungry I am”).

3 points = Stimulus-related extrapolation
This category represents an intermediate zone between stimulus-bound thinking and instances of “pure” mind-wandering. The thoughts differ from the previous stimulus-bound category in that they clearly denote a shift beyond the immediate perceptual features of the stimulus shape, the task itself or environmental/sensory factors. Nevertheless, level 3 responses cannot be classified as pure instances of mind wandering as inherent in these responses is a degree of reliance on the experimental stimulus.

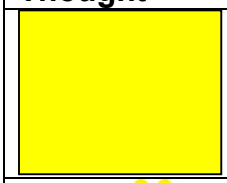
Responses scoring 3 points are characterised as *being tied by comparison to the stimulus*, and they suggest that the individual has relied on immediate features of the stimulus to generate some additional, comparative mental imagery. For example, “It’s like the sun [or draws a comparison to any other entity of a similar shape/colour]”; “It reminds me of an Archbishop’s hat”). Similarly, any kind of manipulation of the shape (e.g., I thought about turning 2 sides up (of the cross) and folding them back) or interaction with the shape (e.g., I was thinking about skating down it (the triangle), on my feet) would also be awarded 3 points as it still demonstrates a direct link to the stimulus.

A score of 3 may also be given to attempts to mind wander that are not fully fledged, (e.g., “I’m trying to think of something in nature”). These responses indicate that the person is attempting to engage in mind wandering, but such attempts are not fully formed and lack in richness of detail.

4 points = Mind Wandering
Responses scoring a 4 indicate that the individual has engaged in an instance of pure mind wandering. Such responses should clearly demonstrate that the individual has moved beyond the immediate stimulus features and beyond comparisons that are inextricably tied to the stimulus. Level 4 responses therefore represent thoughts that are stimulus- / task- / environmental – *independent.*

Mind wandering trajectory
Mind wandering can potentially be achieved via distinct routes – (i) namely an instant or direct route in which in the participant immediately engages in spontaneous mind-wandering upon viewing the shape, or (ii) a stepwise manner in which the individual progressively works their way from stimulus-bound through to stimulus-independent forms of thinking, ultimately loosening the associations from the stimulus to engage in pure mind-wandering. See Table 1 below for an example of the stepwise progression from stimulus-bound to mind wandering thinking.

Table 1: Example of mind wandering trajectory.

Thought	Response	Thought classification
	"It's a yellow square"	Level 1 – nothing or labelling of shape.
yellow	"I like the colour yellow"	Level 2 – stimulus-dependent
	"The colour reminds me of sunshine and lemons"	Level 3 – stimulus-related extrapolation
	"On my way home, I'm going to pick up some lemons and make a lemon meringue pie"	Level 4 – Mind-wandering. Content analysis: Episodic future thinking/planning.

Section two: Content analysis

The content of mind wandering responses is inherently broad, however common themes have emerged on the mind-wandering task including:

- Thoughts related to events in the *past* or upcoming events in the *future* and *planning*, e.g., "I'm remembering when we went on holidays and we stopped off at the Pyramids in Egypt" and "I'm thinking of what I need to pick up on my way home"

- Thoughts with *social/theory of mind* considerations where the individual may be wondering in a socially oriented way about the experimenter or other individuals (e.g., “I’m wondering what you are going to get out of all of this”, “I’m wondering what you are thinking about while I’m looking at these shapes?”),

- *Introspection* about aspects of their own personality, or *personal semantic details* relevant to themself or others (e.g., “I think positively”; “My daughter is a nurse”). In such instances, a clear shift away from the shape must have occurred.

Whereby the Overall Performance scores quantify the *frequency* with which an individual engages in mind wandering, this second stage of analysis characterises the *content* of mind-wandering instances using a qualitative approach.

Only trials on which an individual achieved a score of 4 points, denoting pure mind wandering, are included in the content analysis.

Step 1: Thought Segmentation
In a first step, thought segmentation is performed. As individual differences may affect the frequency of spontaneous thoughts reported during each mind wandering trial, it is important to determine the number of mind wandering instances on each trial awarded 4 points.

Examples of mind wandering instances within the one trial:

1) Response: *“I was thinking about what I was thinking about... also that it’s cold in here... and maybe what I’m going to have for lunch later on”*

The above response contains two separate mind wandering statements (underlined) that can each be graded in the content analysis.

2) Response: *“That’s a lovely blue triangle, reminds me of a house... looks like the house we stayed in on our trip to England last year”*

The above response contains only one statement that would be classified as mind wandering.

3) Response : *“I thought about the people I saw today and how we chatted with them outside the unit... then I wondered about how my husband is doing and that it’s nearly time for his pills... then I thought about what you could possibly be trying to deduce from this task”*

The above response contains 4 separate statements that could be classified as mind wandering.

Note: If person gives 2 or more identical classification 4 statements within the one response, score only the first one as an instance of mind wandering and ignore all subsequent repetitions.

Step 2: Content Classification
Once thought segmentation has been performed for each mind wandering trial (i.e. trials awarded a score of 4), each instance of mind wandering is then classified according to the predominant content type.

The content classification system is based on the anatomically and functionally dissociable subsystems of the default mode network outlined by Andrews-Hanna JR (2012, The brain's default network and its adaptive role in internal mentation. *The Neuroscientist* 18:251-270). Converging research suggests that different subsystems of the default mode network, namely the medial temporal lobe (MTL) and dorsal medial prefrontal cortex (dMPFC) subsystems, underpin discrete aspects of internal mentation. Functions associated with the dMPFC subsystem are broadly described as introspection about the mental states of self or others, whereas the MTL subsystem has been associated with memory-based construction and simulation.

Category 1: Introspection/metacognitive-based thoughts
Introspective/metacognitive-based thoughts are broadly described as introspection about the mental states of self or others.

Responses in this category are generally comprised of:

Introspection/metacognitive-based content	
- Personal semantics	**- Self-referential statements**
- Appraisal of own mental state	**- Appraisal of other's mental state**
- Social reasoning	**- Thought/concern for others**
- Metacognition	

Examples of Introspective/metacognitive-based statements include:
"I was thinking about what I was thinking about" (Metacognition)
"I wondered about how my husband is doing" (Thought/concerns for others)

"I thought about what you could possibly be trying to deduce from this task" (Appraisal of other's mental state)

Other examples are:
"My daughter is a nurse" (Personal semantics)
"I'm thinking positively" (Appraisal of own mental state)

Category 2: Memory-Based Construction/Simulation

The memory-based construction/simulation mode of mind wandering has been associated with memory-related processing, scene construction and mental imagery.

Responses in this category are generally comprised of:

Memory-based construction/simulation content	
- Episodic / autobiographical memory	**- Contextual associations (non personal)**
-Episodic future thinking	**- Semantic/conceptual associations**
- Prospective memory/planning	**- Imagery/imagination**
- Scene construction	**- Navigation**

Examples of memory-based construction/simulation mind wandering include:
"I'm thinking about what I'm going to have for lunch later on" (Prospective thought/planning)
"It looks like the house we stayed in on our trip to England last year"(Episodic / autobiographical memory)
"It's nearly time for my husband's pills" (Prospective thought/planning)

Other examples are:
"I imagine people using the shapes to do patchwork" (Scene construction, Imagery/imagination)
"It reminded me of visual illusion quizzes" (Contextual associations)

Figure 1: Excerpt from a scored protocol highlighting instances of mind wandering classified according to qualitative content analysis. Blue = Introspective/ metacognitive-based content; purple = Memory-based construction/simulation content.

	Response	**External Events** **(noises/distractions/ subject getting restless...)**	**Score**
Practice **(30s)**	The shape was a parallelogram, rather than a square – it was a nice red colour.		2
Shape 1 **(60s)**	Made me think of Greece and I imagined a boat sailing in the Greek islands... then I wondered what you might be expecting me to say.	People talking outside room	4 (2 Mind wandering instances)
Shape 2 **(30s)**	Looks like the sun. My daughter came home sunburnt from the beach yesterday. I hope she is feeling ok now... Then I started thinking about the family holiday we have planned after Christmas.		4 (3 Mind wandering instances)
Shape 3 **(20s)**	I didn't really like the brown colour. The shape made me thing of the tail of an aeroplane. I am so scared of turbulence on planes!	Noise of a door banging	4 (1 Mind wandering instance)

Data analyses:

Performance measures can be obtained from both the overall performance scores and the qualitative continent analysis.

Overall performance scores:

- Performance across the 9 trials can be summed to create an overall score (maximum score = 36), which represents an individual's overall propensity towards stimulus-bound thoughts (lower scores) or pure instances of mind wandering (higher scores).
- To represent frequency of mind wandering, proportion scores can be created for each level of responses. Overall frequency of mind wandering is

represented by the proportion of level 4 responses achieved across the 9 trials (i.e. total amount of 4’s/9 * 100).

- The effect of stimulus duration (i.e. “short”, “medium” or “long”) can also be explored with respect to frequency proportion scores.

Content analysis scores:

- Using the “thought segmentation” procedure, a value is obtained for each individual that indicates how many examples of mind wandering they produced across all of their level 4 responses indicates how many examples of mind wandering they produced across all of their level 4 responses.
- The relative proportions of introspection/metacognitive-based thought content versus memory-based construction/simulation thought content can be obtained with respect to the total instances of mind wandering (e.g., total introspection/metacognitive-based thoughts divided by total instances of mind wandering *100).