Getting out of Bed: Students' Beliefs

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Responses of 223 students in grades 6 to 11 to questions related to beliefs about getting out of bed on the left side are analysed from two perspectives. On one hand the items explore subjective beliefs about chance. On the other hand the different wording and context of the items provide opportunity to show different levels of understanding of students' explanations. Rasch analysis is used to place the items on a scale with other statistical literacy items in order to suggest potential levels of difficulty.

Background

Over the years there appears to have been a rise and fall in interest related to students' subjective beliefs about probability. In 1972 Kahneman and Tversky (1972) introduced the representativeness heuristic to explain people's subjective solutions to probability problems based on an event's similarity to its parent population or the way in which it was produced. This was followed by Tversky and Kahneman's (1973) availability heuristic related to subjective decisions on probability based on remembered incidents or scenarios. Fischbein (1975) suggested that preconceived ideas and superstitions could influence children's probabilistic decisions before the age when they reached the stage of formal operations. Fischbein and Gazit (1984) followed this work in a study of teaching intended to change such beliefs.

Subjective factors specifically affecting students' explanations of outcomes from trials in contexts where equally likely random outcomes should be expected, such as coins, dice, and urns, were studied by J. Truran (1985) and K. Truran (1995). The beliefs they uncovered included the use of mental powers, the use of physical manipulation, the need to change outcomes on multiple trials, the intervention of outside forces (such as God), the need to achieve a specific outcome for a game, the attribution of luck (or lack of luck), the kind of material out of which a device is constructed, and the greater difficulty of getting outcomes associated with higher numbers.

In a 1999 review of cultural influences on subjective beliefs about probability, Amir and Williams concluded, "it is widely believed and accepted that the children bring informal knowledge acquired in daily life from their culture which might interfere with their learning of probability" (p. 85). Their study in England sought to characterise these influences. On one hand the cultural influences included superstitiousness, religiousness, personal experience with games, and interpretation of language used to describe probabilistic occurrences. These influences were similar to those described by Truran (1995). On the other hand they also identified biases identified earlier as representativeness, equiprobability, and availability, as well as the outcome approach of Konold (1989).

Recently Sharman (2014) again considered the influence of culture on probabilistic thinking, using examples from research carried out in Fiji. From a very different cultural setting than Amir and Williams (1999), she reported similar attributions to their research, calling for more research from this perspective.

2015. In M. Marshman, V. Geiger, & A. Bennison (Eds.). *Mathematics education in the margins* (Proceedings of the 38th annual conference of the Mathematics Education Research Group of Australasia), pp. 619–626. Sunshine Coast: MERGA.

The current study

The current study arose following the previous use of a survey item some years earlier (Watson, Collis, & Moritz, 1995). The item, called *James* here was adapted from an item used by Fischbein and Gazit (1984): "Joseph endeavours to enter the classroom, each day, by putting the right foot first. He claims that this increases his chances of getting good marks" (p. 5). Fischbein and Gazit did not ask for explanations, only an opinion of "Yes" or "No", where "No" was correct. There was no reward for suggesting "Yes" that the belief might help Joseph and the overall results were inconsistent across grades and teaching conditions (p. 14-15). Joseph became James, and his action to increase his chances of getting good marks was to get out of bed on the left side.

The original James item was used in surveys with 1014 students in Years 3, 6, and 9 (Watson et al., 1995) and assessed using the SOLO model (Biggs & Collis, 1982). Overall, 58% of students (rising from 43% in Year 3 to 68% in Year 9) dismissed the claim, whereas between 5% of Year 3 and 30% of Year 9 could offer more sophisticated reasoning about James' beliefs. Later the item was included with two other belief items in a longitudinal study (Watson, Caney, & Kelly, 2004) that looked at change over two and four years and compared beliefs about chance with chance measurement questions. For the James item the change over four years for 148 students starting in Year 3 was from 63% to 73% for dismissing the claim and from 4% to 16% for providing more sophisticated reasoning. For 117 students initially in Year 6 the change to Year 10 was an increase from 64% to 68% for dismissing the claim and from 14% to 23% for giving more sophisticated reasoning. The positive change in performance for the combined belief item scores was significant in each 2-year period.

The James item might not have been used again except for a media item that addressed the specific issue of getting out of bed on the left side. The article from Reuters news agency is reproduced in Figure 1 (Majendie, 2008). Because of the existence of *expert* opinion, it was decided to include the supporting evidence and see how it influenced students' opinions about James' belief. The amended items are in Figure 2, with items 1 (JMES), 2 (FENG), and 3 (PSYC) included in one survey of statistical literacy and item 4 (BED) included in a parallel survey. Hence in one survey, students could make three responses in relation to getting out of bed on the left side, whereas in the other only one item was used combining the opinions of the experts.

Getting out of bed on the left side is the right side

Sleep scientists, feng shui experts and psychologists put their heads together to analyse the best way to get up in the morning.

Left is best, they decreed in a study undertaken by the hotel chain Premier Inn.

Feng shui expert Jan Cisek said getting out of the bed on the left is associated with all that people hold dear – family and health, money and power.

Psychology and motivation expert Pete Cohen said the left side helps us all to think rationally about the day ahead.

"The right side of the brain is responsible for emotions like fear and stress which only dilute your potential for having a positive experience," he said.

Figure 1. Getting out of bed on the left side is the right side (Majendie, 2008).

Item 1 – JMES

Every morning James gets out of the left side of the bed. He says that this increases his chance of getting good marks.
Explain what you think of this claim.

Item 2 – FENG

Now consider a newspaper headline:

> **Left is the right way to exit bed**
> Feng shui expert Jan Cisek said getting out of the bed on the left was associated with all that people held dear – family and health, money and power…

Explain what you think of this claim.

Item 3 – PSYC

Also in the same article:

> **Left is the right way to exit bed**
> …Psychologist Pete Cohen said that getting out of bed on the left side helped us to think rationally about the day ahead.

Explain what you think of this claim.

Item 4 – BED

The following extract is from a newspaper.

> **Left is the right way to exit bed**
> Feng shui expert Jan Cisek said getting out of the bed on the left was associated with all that people held dear – family and health, money and power. Psychologist Pete Cohen said the left side helped us to think rationally about the day ahead.

Explain what you think of these claims?

Figure 2. The four probabilistic reasoning items used.

The introduction of the authentic media extracts places the items in Figure 2 in a cultural context not considered in previous research. The purpose of this analysis, hence, is to explore what difference the form of question makes in eliciting student responses to the belief about getting out of bed in a particular fashion and its effect on life situations, especially James' chances of getting good marks. Do students respond differently to the different stimuli and how does the sophistication compare with other statistical literacy questions?

Method

Sample

All participants were students who were part of the StatSmart project and who had already completed at least three StatSmart assessments (see Callingham & Watson, 2007 for details of the research design). These students were all in classes with teachers who were part of the project at a point during the study when they did not have to undertake an assessment but where their peers were undertaking one of the StatSmart tests. Teachers requested another test to occupy the small numbers of students in their classes who fell into this category, and this situation provided the opportunity to trial new items, including the four of interest: BED (Test Form X), JMES, FENG, and PSYC (Test Form Y). Of the 248 students (M, n=132, 53.2%; F, n=116, 46.8%) from three different states (South Australia, Tasmania, and Victoria) who undertook the two test forms, 229 provided valid answers to one or more of the four target items. The distribution of valid responses to these items across grades is shown in Table 1, broken down by test form.

Table 1
Number of students in each grade for each survey

Grade	6	7	8	9	10	11	Total
Form X	5	27	11	31	25	4	103
Form Y	8	23	23	24	48		126
Total	13	49	33	54	70	4	229

Instruments

The two test forms consisted of 23 (Test X) and 25 (Test Y) items of which 20 were common to both forms. The common items were taken from an item bank of statistical questions that had been used in a number of past studies to measure statistical literacy (e.g., Callingham & Watson, 2005), including some also included in the StatSmart tests. Because the two test forms were linked by common items they could be placed together on the same measurement scale using Rasch analysis, and ultimately linked to the larger StatSmart data set. Both tests and the items within them, through a consideration of fit to the Rasch model, met the standards required to allow valid inferences to be made from the data (Bond & Fox, 2007).

Analysis

All items were coded using rubrics developed on the basis of the complexity of response. The specific rubric used for all four target items is shown in Table 2.

Table 2
Rubrics used to code Getting-out-of-Bed items

Code	Description
0	No response
1	Agreement with James or Feng shui expert or Psychologist
2	Rejection of claim; simple disagreement with no justification
3	Presentation of one argument, either based on a lack of evidence, physical conditions, or based on a psychological belief that may assist performance
4	Combination of more than one argument, based on lack of evidence, physical conditions, and/or based on a psychological belief that may assist performance

Coded responses were analysed using Winsteps 3.80.1 Rasch measurement software (Linacre, 2013). In addition, examples of the text responses were collected as exemplars of different levels of response. A map of all the items, showing the relative difficulty of the items with their different coding levels, was produced by the software. This was examined to determine how the items behaved relative to each other, as well as in relation to other items. In addition, the map was compared qualitatively with Callingham and Watson's (2005) Statistical Literacy Hierarchy, using items from the earlier study to suggest possible levels on the hierarchy for the new items.

Results

Figure 3 shows the item map produced by the software showing all of the items in both X and Y surveys. The items of interest are shaded. The number attached refers to the code as shown in Table 2. Each # represents 3 students and the scale is shown in mean logits (mean of the log of the odds of response), the units of Rasch measurement. Items shown at the top of the scale are the hardest.

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Figure 3. Item map of all items in X and Y surveys including coding levels.

All of the target items showed good spread along the scale, with the highest code for each item being among the hardest items in the surveys. Agreement and simple rejection of JMES appeared easy for students, but all codes 1 and 2 appeared on the bottom one-third of the scale. Examples of code 1 responses—agreement with the claims—included the following:

JMES: It is his lucky side.

FENG: I think that Jan Cisek thinks getting out of bed on the left side is lucky.

PSYC: Because your brain will work better.

BED: That it better to get out left side of bed.

Of interest is that for the PSYC item, using the psychologist's claim, students seemed somewhat more likely to use answers based on the workings of the brain, whereas with other items they tended to attribute responses to luck. Code 2 responses—simple rejection—included:

JMES: I think it makes no sense.

FENG: It's a superstition.

PSYC: I don't really get this claim, I really don't see how getting out of bed on the left side helps this.

BED: I think that these claims explain what experts think, however, I would not agree with them.

Students could recognise that the claims were made by *experts* and did not necessarily agree with the claims, but were unable to articulate a rationale for their disagreement.

There was a jump in difficulty from code 2 to code 3, shown by the relatively large gaps on the map. It seemed that for students to articulate their rejection of the claim required a greater level of understanding of the context and validity of the claims. Code 3 responses included:

JMES: It can help because it put [*sic*] him in a good mood.

FENG: Feng shui relies on supernatural that is unmeasurable elements so it would be unwise to think anything about it other that it is improbable.

PSYC: No proof. Unless there has been a scientific study, there is no way of knowing.

BED: It doesn't matter really. How can getting up a different way effect [*sic*] your thinking? If you believe it, it might happen.

FENG was more likely to be rejected on the grounds of supernatural or spiritual beliefs, whereas the effects of a belief about getting out of bed on a particular side were often cited as possibly being positive for the person concerned for the other items. Physical conditions, such as the bed being against the wall on the left side were also used as justification for rejecting the claim.

Code 4 responses were very difficult for students to achieve, particularly for JMES and FENG. Examples of code 4 responses included:

JMES: I think that this claim is irrational as it does nothing to change his chance of getting good marks, it's a superstition. But, if he believes it works, this could influence his

> marks either in a good way, because he is positive about it, or in a bad way, because he believes that it is all he has to do to achieve good marks.

> FENG: Left is where the heart is, so spiritually people might think strongly about this, but there is no physical evidence.

> PSYC: This is just a claim. There is no particular evidence of it and for some people their beds may be against the left side of the wall so how do they get off the bed on the left. Does that mean they think less? Again, I think there is no science or proof, only superstitious beliefs.

> BED: I think that while they're interesting, there is no proof given in the article to actually say that the left side is better. These are only opinions, yet the title seems to state that it is better to get out of bed on the left side. Besides, what if the left side of your bed was up against a wall?!

Students responding at this level were able to conjecture about different conditions or ways in which the person concerned might be affected by their superstition or belief. They sought evidence or scientific proof. The relative difficulty of making a code 4 response to JMES and FENG may be because students could not see any possible merit in the justifications provided for the claim, and hence were unable to discern any plausible arguments that could be used. The PSYC and BED items, on the other hand, tended to attract responses that alluded to scientific or experimental evidence.

The informal comparison of the item map with the Statistical Literacy Hierarchy suggests that all code 4 responses were at the highest level of the hierarchy — Critical Mathematical. The descriptor for this level states that respondents demonstrate a "Critical, questioning engagement with context, using proportional reasoning particularly in media or chance contexts, showing appreciation of the need for uncertainty in making predictions, and interpreting subtle aspects of language" (Callingham & Watson, 2005, p. 3). At the other end of the scale, most code 1 responses appeared to be at the Informal level where responses show "Only colloquial or informal engagement with context often reflecting intuitive non-statistical beliefs, single elements of complex terminology and settings, and basic one-step straightforward table, graph, and chance calculations." The descriptors for these levels seem to be appropriate to the nature of the responses to the four items provided by participants in this study. Further work is needed to place the intermediate codes accurately in levels of the hierarchy.

Discussion

In this study four items addressing students' subjective beliefs about probability were used with other items that targeted more traditional statistical content, including central tendency, graph reading, and numerical probability. All items worked together to provide a single measurement scale, and the four focus items showed a progression in difficulty that was well spread out along this scale.

It could be considered that these items were not mathematical in their nature. No quantification of probability was given and they required no calculation. Responding to these items, however, did demand statistical reasoning especially at the high levels of response. The language demands of statistics can make it challenging for teachers, but the need to be able to *tell the story* (Pfannkuch, Regan, Wild, & Horton, 2010) is exemplified by the demands of context such as shown in the items used in this study.

The nature of the subjective beliefs about probability demonstrated by students in this study was similar to those shown in earlier research (e.g., Amir & Williams, 1999;

Fischbein, 1975; J. Truran, 1985; K. Truran, 1995; Tversky & Kahneman, 1973). The beliefs shown by students in this study included the supernatural, the importance of physical conditions, psychological beliefs, and trust in the scientific method. Students drew on their sometimes limited understanding of context to reason about the situations presented, such as knowledge about the right and left brain.

Being able to present a coherent, critical argument about a situation, referring to the evidence provided, is an important component of statistical reasoning. The students reported here had already been part of a large-scale study, StatSmart, for at least a year. The relative difficulty that they demonstrated in making high-level responses indicates that more work is needed to help students develop the language of statistics. Providing opportunities for students to reason about probabilistic contexts beyond the classroom activities of tossing coins and dice is an important step to developing the critical statistical reasoning skills needed in the complex society in which they live.

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