

James A. Reggia,
Di-Wei Huang and
Garrett Katz

Beliefs Concerning the Nature of Consciousness

Abstract: *The opinions that people hold about the nature of consciousness are important not only to researchers in philosophy and science, but also in many professional fields such as clinical medicine, law, and education. However, in spite of this importance and how controversial the topic is, there is remarkably little empirical data concerning what these opinions are. Here we describe the results of a multi-year survey of university students concerning their beliefs about the nature of consciousness and about what entities (other people, animals, computers, etc.) are conscious. We find that these students are split fairly evenly between dualists and materialists, and that they also include a significant number of idealists. Almost all of the participants attribute consciousness to other people, and the vast majority attributes it to at least some animal species but not to computers. These results, especially when combined with those from the few existing previous surveys that we review, do not support past statements in the consciousness studies literature that dualism is by far the dominant viewpoint in the general population (or at least for that portion of the population that goes on to a university education). The results also indicate that most people resolve the problem of other minds in a way that includes some animals as being conscious.*

Keywords: survey; mind–brain problem; problem of other minds; experimental philosophy; nature of consciousness; philosophical preconceptions.

Correspondence:

James A. Reggia, Department of Computer Science and UMIACS, University of Maryland, College Park, MD 20742, USA. Tel: 301-405-2686.

Email: reggia@cs.umd.edu

Introduction

Understanding the different viewpoints that people hold concerning the nature of consciousness is obviously important in fields where the mind–brain problem is studied. For example, in philosophy, psychology, neuroscience, and AI, differing opinions held by researchers can influence the selection of which problems do or do not merit scientific study, determining how these problems should be studied, and even deciding whether issues involving consciousness are amenable to scientific study at all. What is perhaps less obvious is that people’s perspectives on the nature of consciousness can also be quite important in a variety of other contexts. For example, it has been found that judgments made by modern psychiatrists and psychologists may be influenced at times by a clinician’s (perhaps covert) acceptance of dualism (Miresco and Kirmayer, 2006). It also seems likely that medical doctors dealing with disorders of consciousness, such as vegetative states, would be influenced by their conception of the mind–brain relationship as they struggle with challenging ethical questions about patient treatment (Farisco *et al.*, 2014). In education, broadly conceived, where an instructor may be conveying experimental results about neurobiological correlates of consciousness, the interpretation of those results by a student may be heavily influenced by the student’s preconceived acceptance of dualism versus materialism. Thus, for example, an instructor facing the difficult task of introducing college students to the formal study of natural or machine consciousness might want to tailor their instruction substantially based on the *a priori* views/biases of their students.

Given the importance of understanding the viewpoints that people hold about the nature of consciousness, one is naturally led to enquire what those viewpoints are. At the present time, the prevailing wisdom on this issue among academicians is that almost all modern professionals/researchers in fields where the mind–brain problem is studied are materialists or functionalists, while the non-expert public consists primarily of dualists. We will refer to this as the *complementary beliefs hypothesis* in the following. It is easy to find statements consistent with this hypothesis in the literature. For example, Searle asserts that ‘most people in the Western world today accept some form of dualism’, while ‘almost without exception, professional

experts in the field¹ accept some form of materialism' (Searle, 2004, p. 12). Or, 'dualism... is the most common theory of mind in the public at large,... and it has been the dominant theory of mind for most of Western history', but 'functionalism is probably the most widely held theory of mind among philosophers, cognitive psychologists, and artificial intelligence researchers' (Churchland, 1984, pp. 7 and 37). Or even more strongly, 'Almost all modern-day scientists are, at least on the surface, fierce materialists' (Pockett, 2000, p. vi), while 'AI workers are, by and large, naïve materialists and mechanists, and for them those are not positions to be justified' (Wilks, 1984, p. 105). Is the complementary beliefs hypothesis correct?

Another perspective on people's viewpoints about the nature of consciousness can be obtained by examining how, in daily life, they attribute the presence or absence of consciousness to entities that they encounter in the external world. This issue relates to the well-known *problem of other minds* (Bayne, 2009; Searle, 2004) — there is no known objective way in which one can determine whether or not another person is conscious and has a mind. Presumably most of us make the assumption that other people are conscious based on analogy or on a kind of parsimony principle: this is the simplest explanation for what we observe in other people. However, attributing consciousness to an external entity becomes much more challenging when we enquire whether or not animals or machines (current or future) are conscious. Where, if anywhere, do people draw the line between conscious and non-conscious entities?

People's beliefs about the two questions above are, perhaps in contrast to the nature of consciousness itself, open to objective experimental study. Surprisingly, however, there are remarkably few data available that address such questions. For example, statements like those quoted above about the prevalence of dualism versus materialism in different groups of people are largely personal opinions of uncertain accuracy. To our knowledge, based on a substantial literature search, only a very few previous surveys have collected relevant information. In the following, we report the results of a new survey concerning human and machine consciousness. Combining these results with those from the few earlier surveys that involved different populations, we then examine the extent to which the complementary

¹ Searle explicitly indicates that such professionals are in philosophy, psychology, cognitive science, neurobiology, and AI.

beliefs hypothesis is supported or not, and how people attribute consciousness to other entities. Based on this analysis, we suggest that the situation is more complex than is generally recognized.

Methods

The primary subjects in this study were 228 university students in one of two courses offered at the University of Maryland during the years 2010–2013. Of these students, 169 were undergraduates taking an annually offered introductory course on artificial intelligence (i.e. 40+ students per year). This course was given by the computer science department, but was open to students in any major. Student majors spanned a broad range of those available at the university: 56% computer science, 15% undecided, 11% engineering, 8% sciences (biology, physics, psychology, etc.), 6% humanities, and 4% business, economics, and education. Most of the students were in their first two years of college: 42% freshman, 34% sophomores, 15% juniors, and 9% seniors. The remaining 59 subjects were graduate students taking one of two offerings of a graduate-level course on neural computation technology. This second course was offered twice during this period (i.e. roughly 30 students per offering). These graduate students were in computer science with the exception of two or three in each class who were instead in engineering or applied mathematics.

A survey consisting of three questions relevant to natural and machine consciousness was administered simultaneously to all present students in each class very near the end of the course. Up until the time of this survey, there had been no discussion of consciousness, natural or artificial, in the classes — preceding sessions had been devoted largely to technical discussions of AI or neural computation. The primary purpose of the survey was to serve as a teaching instrument: it was intended both to assess student preconceptions as a guide to the instructor, and to provide results for class discussion. With respect to the latter, the results of the survey in each class were tabulated and presented to the students during the following class. This subsequent class dealt with the nature of consciousness and the prospects for machine consciousness. The intent in discussing these results with the students was to demonstrate the controversial nature of the topic in terms with which students could identify.

In asking students to answer the survey questions, they were told that we would be discussing ‘strong AI’ in the following class. Previous material throughout the semester had focused on ‘weak AI’, or

in other words, on machine intelligence based and judged solely on behavioural criteria. There was no announcement that this survey would be given prior to its administration. Students were allotted fifteen minutes to provide answers, and all finished well before that time was up. The specific verbal instructions given to the students each time the survey was given are presented at the beginning of Appendix A.

The survey questions were intended to obtain quickly some basic information about a student's preconceptions concerning, in theory, the nature of consciousness, and about how, in practice, they attributed the presence/absence of consciousness to entities in the real world. The survey was not intended or designed to assess in depth a student's philosophical perspectives or to address subtle distinctions related to consciousness studies.

The complete half-page survey form used is given in Appendix A. The first question asks a student to rate on a scale of 1 (very improbable) to 10 (very probable) how well each of three philosophies match their personal beliefs. The three descriptions to be rated correspond to dualism, idealism, and materialism. Since it was presumed that most of these students were unfamiliar with the names of these three viewpoints, an informal one-sentence definition of each was used instead of their names (see Appendix A). The remaining two questions concerned what entities a student considered to be conscious. The second question presented a list

yourself, other people, monkey, dog, squirrel, fish, ant/worm, tree, thermostat, rock

of ten concrete physical entities ordered as shown. Students were asked to draw a vertical line that best separates the conscious from unconscious entities on this list. The third and final question continued this thread by asking whether or not the student believed that contemporary electronic computers are conscious. This third question was not added to the survey until after the first offering of the undergraduate AI course, so the total number of students answering it is smaller than for the other two questions.

These three questions are obviously quite limited in scope and depth. They intentionally ignore many refinements on the concepts of dualism and monism, and many sometimes-subtle aspects of natural and artificial consciousness. The survey questions are intended solely to provide a coarse measure of an individual's preconceived viewpoints concerning the nature of consciousness and what entities are

conscious in a rapid fashion that is consistent with practical time constraints existing in a classroom setting.

The handwritten student responses were manually encoded in a computer file that was checked multiple times to minimize the possibility of any data entry errors. Two students were found to have incorrectly (according to the instructions — see the survey form in the Appendix) entered 0's rather than 1's in some of their answers to the first question. These few 0's were changed to 1's during data entry for consistency with all of the other students' answers. The vertical line location forming a student's answer to the second question was encoded numerically in ascending order. Specifically, the numerical values used for each possible line location were:

- 0 to the left of all entities;
- 1 between 'yourself' and 'other people' (solipsism);
- 2 between 'other people' and 'monkeys' (humans only);
- ...
- 10 to the right of all entities (panpsychism).

Thus this scale is treated *a priori* (and in a biased fashion) as being linearly ordinal to facilitate summarizing results. The data analysis underlying the results reported below was primarily done using Matlab. We used the two-sample t-test to assess the statistical significance of differences between means, the paired-sample t-test to assess differences in paired responses, and a Chi-square test for the analysis of Question 3.

Results

In the following, we characterize the results from our primary survey of 228 students according to whether they address the issue of philosophical viewpoint or the issue of which entities are conscious. We also briefly describe the results of giving the survey to a small group of external students at another university as an informal control.

Philosophical Viewpoint (Question 1)

In answering Question 1, students ranked how well each of three philosophical viewpoints about the nature of consciousness matched their own personal beliefs on a scale of 1 (disbelieved) to 10 (believed). To simplify description of the results, we refer to each of the three viewpoints (see Appendix A) as:

- dualism – there are two realms of existence, the physical and the non-physical spirit or soul;
- idealism – primary reality is mental, the physical world being an illusion; and
- materialism – primary reality is physical, the mind being the physical/functional properties of the brain and having a scientific explanation.

Using this terminology, subject responses can be analysed/interpreted in a number of different ways that could potentially produce different results. To minimize this possibility, we analysed the data in three ways (mean raw scores, highest ranked response, and ‘normalized’ scores), as follows.

One way to examine these responses is to consider the mean raw scores of student personal beliefs. As shown in Table 1, dualism and materialism tended to be ranked highest overall, with idealism being ranked only about half as high as the other two viewpoints. While materialism was overall somewhat more favoured than dualism, this difference was not statistically significant ($p = 0.15$; t-test), while the paired differences for dualism/materialism versus idealism were highly significant ($p < 0.05$; see also Table B.1, Appendix B, column 1). The differences that exist between dualism and materialism are entirely due to graduate students favouring materialism more strongly/frequently, as can be seen when undergraduate and graduate student responses are averaged separately (right two columns of Table 1). The statistical significance of the pairwise differences for undergraduates was the same as for overall, but for the graduate students the pairwise differences were all statistically significant ($p < 0.05$; see Table B.1, cols. 2, 3). Interestingly, graduate students also ranked idealism higher than undergraduates did, on average. Differences in means between undergraduate and graduate rankings were statistically significant on all three rows of Table 1 ($p < 0.05$; see Table B.2).

	All	Undergrads	Graduates
Dualism	5.5 (3.1)	5.9 (3.0)	4.5 (3.2)
Idealism	2.9 (2.2)	2.7 (2.0)	3.4 (2.7)
Materialism	6.0 (3.1)	5.8 (3.1)	6.7 (2.8)

Table 1. Mean (SD) ratings concerning different philosophical viewpoints.

Another way to examine these responses is to ask which philosophical viewpoint each subject ranked highest. Table 2 shows these results

overall and for the undergraduate and graduate students separately. Some students had clear, strong preferences for a particular viewpoint (e.g. responding 10, 1, and 1 to indicate a strong preference for dualism) while others expressed a more mixed perspective where the highest ranking viewpoints were tied. Accordingly, in totalling the values in Table 2, a 1.0 was added to the total when a student ranked a single viewpoint highest (vast majority of students), a 0.5 was added for each appropriate viewpoint if two viewpoints were ranked highest (14 students: 9 dualism and materialism, 4 idealism and materialism, and 1 dualism and materialism), and a 0.33 was added if all three viewpoints were ranked the same (5 students). The tendency of graduate students but not undergraduate students to favour materialism over dualism is even more evident when the data is analysed in this fashion (right two columns in Table 2).

	All	Undergrads	Graduates
Dualism	94.7 (41%)	80.3 (48%)	14.3 (24%)
Idealism	22.2 (10%)	14.3 (8%)	7.8 (13%)
Materialism	111.2 (49%)	74.3 (44%)	36.8 (62%)

Table 2. Number (%) of times philosophical viewpoint ranked highest.

Finally, note that the instructions for rating different philosophical viewpoints (Appendix A), in allowing students maximal freedom for how they respond, intentionally do not restrict rating values to add up to a consistent total. So, for example, examples of student answers favouring dualism, materialism, and uncertainty included 5, 1, 1 (total: 7), 1, 1, 10 (12), and 10, 10, 5, (25), respectively. Such variations in the total rating values can potentially bias interpretation of the results. To assess whether this occurred, we linearly re-scaled each student's individual rankings for each philosophy to lie on a scale of 0 to 10 (i.e. instead of 1 to 10) and then 'normalized' their three answers to sum to 1.0 total. Thus, the three examples above were rescaled to be (1, 0, 0), (0, 0, 1), and (0.4, 0.4, 0.2), respectively. The means of these transformed responses are shown in Table 3. In spite of this re-scaling, subjects overall again generally favoured dualism and materialism as philosophical viewpoints when these normalized values are used. While undergraduates ranked dualism and materialism in roughly comparable terms, the graduate students are once again seen to have a significantly higher preference for materialism. Tests for statistical

significance of pairwise differences in Table 3 produced the same results with minor exceptions as in Table 1.²

	All	Undergrads	Graduates
Dualism	0.39 (0.29)	0.44 (0.29)	0.27 (0.23)
Idealism	0.16 (0.18)	0.15 (0.17)	0.20 (0.21)
Materialism	0.45 (0.29)	0.42 (0.29)	0.53 (0.29)

Table 3. Mean (SD) normalized ratings of different philosophical viewpoints

Further insight can be obtained by examining a 3D plot of subjects' dualism-idealism-materialism ratings. This information is given from three different viewpoints in the left column of Figure 1. Subject ratings are quite varied, but many students apparently treated their three scores as summing to 12. For example, in the middle panel of the left column, the large circle at the bottom left indicates many strong dualists who gave ratings of (10, 1, 1), while the large circle and plus sign at the upper left represents strong materialists who gave ratings of (1, 1, 10). As can be seen, many other students gave more balanced ratings that summed to 12 or close to it, such as (4, 4, 4), that indicate substantial uncertainty. Such points lie on or near a plane going through the three points (10, 1, 1), (1, 10, 1), and (1, 1, 10) that represent strong dualism, idealism, and materialism, respectively. However, as noted earlier in computing normalized scores and as seen in Figure 1, some students gave responses such as (10, 10, 5) whose sum is far from 12. While it is conceivable that some of these latter students are confused about what is being asked, we believe that it is more probable that they are simply indicating their *relative* preferences for the three different philosophies without worrying about the sum of their answers. Thus, we would interpret ratings (6, 6, 6) as meaning the same thing as (4, 4, 4). This interpretation seems most likely to us because the short written instructions given at the start of the survey explicitly indicate that the three choices are mutually exclusive (see Appendix A; the concept of 'mutually exclusive' was familiar to these students, having been discussed in substantial detail earlier in the courses in the context of pattern classification learning

² The exceptions: dualism > idealism in the graduate column was significantly different but only with $p = 0.05$; and in the row for idealism, rankings were not significantly different for undergraduate versus graduate students ($p = 0.06$). See Tables B.3 and B.4 in Appendix B.

problems). Further, there is no explicit or implicit indication that the subjective ‘beliefs’ (i.e. not probabilities) expressed by subjects should be treated as probabilities or should sum to any quantity.

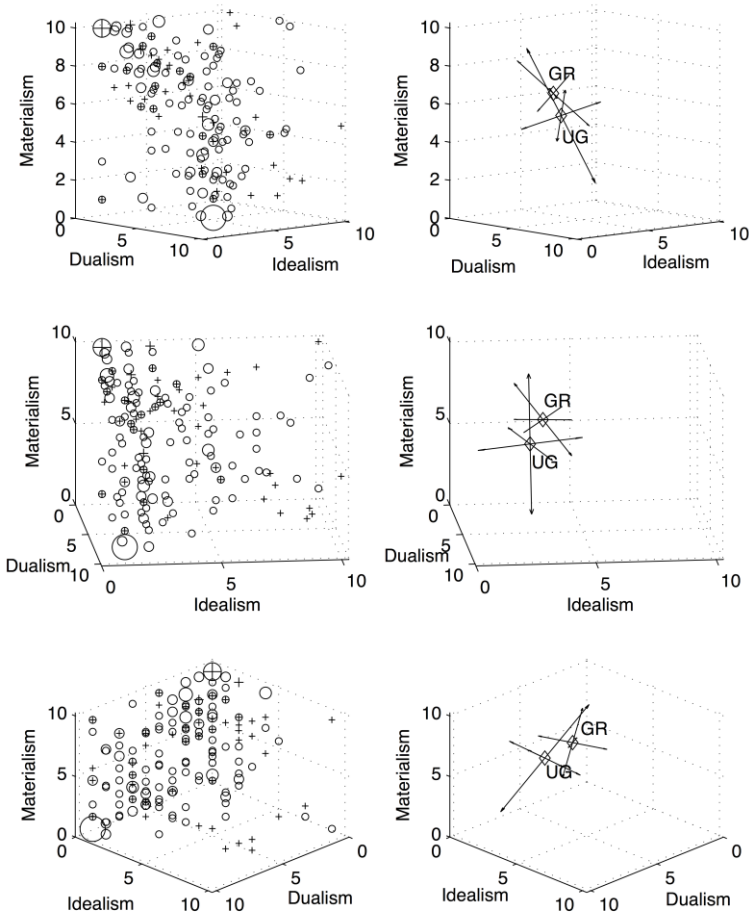


Figure 1. Scatter plots of subject responses. *Left column:* Each 3D point (dualism, idealism, materialism) is a possible rating. The three panels are different perspectives on the same data. The area of each marker is proportional to the number of individuals that gave that particular response. Circles are undergraduates and ‘+’ signs are graduates. *Right column:* The mean response and principal components for undergraduates (‘UG’) and graduates (‘GR’) are shown. Component vectors are scaled proportionally to the variance in that direction. Each panel is again a different perspective on the same information.

The right column of Figure 1 shows correspondingly three different views of the three principal components of the data (generated using the *pca* function in Matlab's Statistics Toolbox), plotted separately for undergraduates (UG) and graduates (GR). For both groups of subjects, the largest principal component runs roughly between strong dualism (10, 1, 1) and strong materialism (1, 1, 10), although for graduates there is more variance towards idealism (1, 10, 1). The proportions of variance along this first principal component are approximately 60% overall, 63% for undergraduates, and 56% for graduates. We would expect to see much less variance in this direction if the complementary beliefs hypothesis were true. The corresponding proportions of variance for the second principal component are 23%, 20%, and 30% respectively, while for the third principal component they are 17%, 17%, and 14% respectively.

Finally, correlation matrices for the three viewpoints of dualism, idealism, and materialism are given in Table B.6 of Appendix B (generated using the *corr* function in Matlab's Statistics Toolbox). We note that there is a substantial negative correlation of 0.51 between subject rankings of dualism and materialism, consistent with the principal components analysis above and the incompatibility of these two philosophical viewpoints.

Identifying Conscious Entities (Questions 2 and 3)

For the second question, subjects were asked to divide the ordered list of physical entities shown in the Methods section above into those that were probably conscious and those that were probably not conscious. Figure 2 shows the overall results and the results tabulated separately for undergraduate and graduate students. The most striking observation here is that responses spanned the entire range of possibilities. A few students indicated that none of the listed entities are conscious (including themselves), while a few indicated that all listed entities are conscious (including rocks). However, the vast majority put the dividing line in intermediate positions. The most frequent dividing line was between animal and plant life ('ant or worm' versus 'tree'), while the mean dividing line location was slightly more to the left between 'fish' and 'ant or worm' (5.8 on the scale given in the Methods section). Overall, 12% of respondents indicated that they believed that only humans are conscious, while 86% indicated that at least some non-human animals are conscious, 53% indicated that all animal life listed is conscious, and 18% indicated that all of the listed

living entities (including plants) are conscious. There was no significant difference in the location of the mean (5.8 and 5.7, respectively) and mode of the responses of the undergraduates and graduates when considered separately, either from each other or from the overall results.

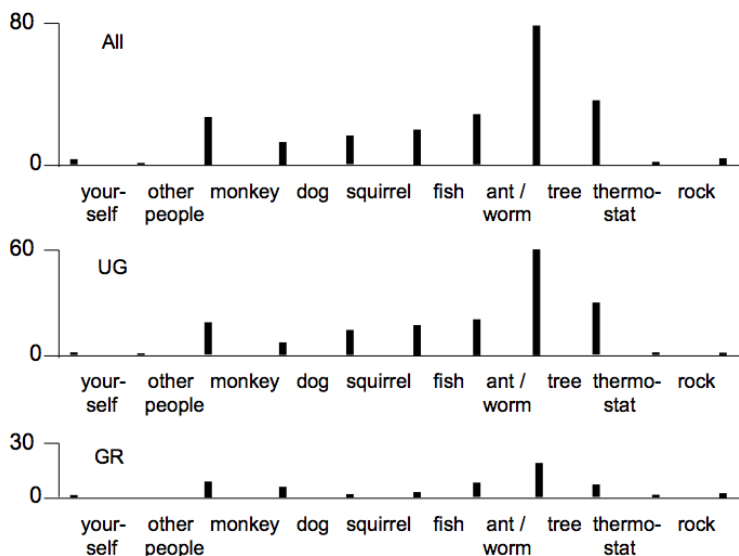


Figure 2. Number of responses at each location when subjects are asked to indicate the dividing line between conscious and non-conscious entities. *Top*: all responses together. *Middle*: undergraduate (UG) students' responses considered separately. *Bottom*: graduate (GR) students' responses considered separately.

Was there a significant difference in how individuals favouring dualism, idealism, or materialism in answering our first question responded in answering this second question? To answer this, we partitioned the full set of respondents into four groups: dualists (52 respondents), idealists (10), materialists (75), and other (91) based on their normalized answers to the first question. Specifically, a person was classified as a dualist if, in their normalized scores, they gave a ranking of 0.6 or above for dualism. Classification as an idealist or materialist was done analogously, and any remaining students not in one of these three categories were classified as 'other' (their scores were distributed more evenly over two or all of the three possible categories). There was no statistically significant difference between

where individuals in these four different groups placed the dividing line between conscious and unconscious entities, based on the mean location of the dividing lines: dualists 5.5 (SD = 2.1), idealists 6.0 (2.4), materialists 5.8 (2.2), and other 5.9 (2.2).

The third and final question asked whether or not the respondent believed that contemporary electronic computers are conscious (n = 184). As seen in Table 4, the vast majority of respondents believe that computers are not conscious. However, approximately 15% overall were uncertain about this issue, and six individuals (a little more than 3%) indicated that they believed computers are conscious. The six latter individuals were all undergraduates. The mean absolute and normalized scores assigned by these six latter individuals to dualism, idealism, and materialism in Question 1 did not appear to be qualitatively different than those for undergraduates in general (Table 1). However, their typical dividing line between conscious and unconscious entities in Question 2 was shifted significantly towards the right (mean value 7.3 versus 5.8 in general), invariably including at least 'squirrel' as being conscious and usually all animal life that was listed. There were no statistically significant differences (Chi-square test; $\chi^2(6, N = 184) = 3.42, p = 0.75$) in how students classified as dualists, idealists, materialists, or other responded to this third question.

	All	Undergrads	Graduates
Yes	6 (3%)	6 (5%)	0 (0%)
Uncertain	28 (15%)	19 (15%)	9 (15%)
No	150 (82%)	100 (80%)	50 (85%)

Table 4. Responses concerning whether computers are conscious.

Taiwanese Graduate Students (Separate Data Collection)

For comparative and control purposes, the same survey was administered subsequent to the above study to a group of 11 graduate students that differed in being from another institution (Johns Hopkins) and from a single cultural background (Taiwan). These students were PhD students in a variety of disciplines who were attending a presentation given by one of the authors (DWH) on artificial intelligence as part of a seminar series. The instructions given were very similar to those used in the classroom settings (see Appendix A), with minor wording changes because of the different context. While the small size of this sample precludes detailed analysis, the responses were largely similar to those for the graduate

students in our main analysis. For example, the mean scores assigned to dualism (5.2), idealism (2.9), and materialism (6.3) were reasonably similar to those assigned by graduate students in the main study (4.5, 3.4, and 6.7 respectively) and even closer to those assigned overall in our study (5.5, 2.9, and 6.0). Both dualism and materialism are rated significantly higher than idealism, while the difference between dualism and materialism is not significant (Table B.5, Appendix B), possibly due to the small sample size. The dividing line mean of 6.6 separating conscious from non-conscious entities in Question 2 was shifted slightly to the right (all answers fell between ‘dog’ and ‘thermostat’, with no responses at either end of the spectrum of listed entities, which is probably due to the small sample size). Seven students said electronic computers are not conscious, three were unsure, and one said they are conscious.

Discussion

Our survey concerning the nature of consciousness is quite limited in scope and depth to permit its rapid administration to individuals who are largely unfamiliar with past work involving consciousness studies. It addresses two issues. The first issue involves a person’s beliefs concerning which of dualism, idealism, or materialism best provides an explanation for conscious mind. Our question on this topic makes no attempt to examine different types of these three philosophical viewpoints, and, accordingly, it only provides a rough measure of a person’s beliefs when compared to contemporary refinements of these philosophies. Nonetheless, the results obtained, when combined with those from the few previous related surveys, prove to be quite informative concerning the complementary beliefs hypothesis discussed in the Introduction. The second issue addressed by the survey concerns whether or not each of a number of entities is likely to be conscious. Our results on this issue relate to how people intuitively handle the other minds problem that is often discussed in the philosophical literature. We discuss each of these two issues in the following.

The Complementary Beliefs Hypothesis

The complementary beliefs hypothesis states that almost all modern professionals/researchers in fields where the mind–brain problem is studied are materialists or functionalists, while the non-expert public consists primarily of dualists. Are our results consistent with this

hypothesis? The university students in our study are certainly not professional experts or researchers in philosophy, cognitive science, AI, or related fields, and they have generally not had previous training in consciousness studies; they are best viewed as part of the general educated public. Thus, according to the complementary beliefs hypothesis, they would be expected to largely be dualists. While we did find that 41% of these students ranked dualism highest, almost half, or 49%, ranked materialism highest, while surprisingly (to us) 10% ranked idealism highest. The large numbers of students ranking materialism highest does not appear to be consistent with the complementary beliefs hypothesis, but such a conclusion can only be tentative since we are dealing solely with individuals who go on to a university-level education. It is possible, if not probable, that the percentage of dualists is substantially higher among that part of the general population who do not advance to a university level of education. However, we know of no past survey that speaks to this latter issue concerning the beliefs of non-college level individuals — there appear to be no objective data on that question. We also note that the complementary beliefs hypothesis does not even conceive of the possibility that a significant number of individuals might indicate a preference for idealism, something that also surprised us in examining our results.

Are the results of our survey consistent with past empirical data concerning the philosophical beliefs of university students? To our knowledge, there have only been two previous surveys of such students, and these, unlike the current study, dealt solely with undergraduate students. The first of these studies surveyed 442 undergraduate students in Germany (Fahrenberg and Cheetham, 2000). These students had a variety of majors, but were mostly psychology students. It is somewhat difficult to compare this earlier study to ours, in part because participating students indicated their preferences as falling into five main categories rather than into three as was done here. The four-page survey used was also much more elaborate than ours, including several sub-types of dualism and materialism, and used a technical vocabulary ('ontological aspects', 'metaphysical questions', 'dialectical unity', etc.) that would probably have been difficult for many of our students to interpret. However, by totalling the responses obtained concerning the nature of conscious mind (Table 1 of the Fahrenberg and Cheetham study), it is evident that of the participating

students 138 favoured dualism, 11 idealism, 159 materialism,³ and 134 believed that the question was unanswerable. Considering just the 308 of these students who gave a specific answer on this issue results in the percentages given for the Fahrenberg and Cheetham study in Table 5. These results are remarkably similar to those obtained independently in the current study (rightmost column, Table 5), the latter occurring more than a decade later and a continent away.

The second previous related study surveyed 250 undergraduate students having various majors in the UK (Demertzi *et al.*, 2009). Participants were asked to agree or disagree with four statements, two of which are directly relevant to the current study: ‘mind and brain are two separate things’ (dualism), and ‘mind is fundamentally physical’ (materialism). No statement relevant to idealism was included. The results of this previous study, shown in the middle of Table 5, are taken from Figure 1 of Demertzi *et al.* (2009), and indicate that 67% of the students agreed with the first statement (dualism), which is a higher percentage than in our current study. However, 36% agreed with the second statement (materialism).⁴

	Fahrenberg & Cheetham (2000), Germany	Demertzi <i>et al.</i> (2009), UK	Current study (2014), US
Dualism	45%	67%	41%
Idealism	3%	—	10%
Materialism	52%	36%	49%

Table 5. Other surveys of university student philosophical viewpoints.

Our survey and the two similar ones summarized above speak to only one claim of the complementary beliefs hypothesis: that individuals who are not in professional fields involved with studying consciousness are primarily dualists. The empirical data from all three of these surveys⁵ are not consistent with this aspect of the complementary

³ We include those students favouring identity theory (reductive materialism) in the Fahrenberg and Cheetham study in the count of 158 materialists given here.

⁴ Presumably some students indicated agreement with both statements.

⁵ Empirical data gathered in other contexts are also inconsistent with the complementary beliefs hypothesis. For example, undergraduate students who were asked whether a robot with an electronic replica of a human brain could experience love (a question intended to assess dualism tendencies) were found to be roughly equally divided

beliefs hypothesis in the sense that there are clearly many materialists in modern society, and also a small but significant number of idealists. What about the second claim of the complementary beliefs hypothesis — that most professionals/experts in fields such as philosophy, psychology, cognitive science, and AI are dedicated materialists? While the above studies do not provide relevant data on this issue, there are two other surveys that do, although the extent to which they capture professionals/researchers in these fields among the respondents is not completely clear. One of these surveys was given to 1,000 participants at the 1996 *Towards a Science of Consciousness* conference (‘Tucson II’), and 212 of these individuals returned completed surveys (Baruss and Moore, 1998). This study used a complex questionnaire having 38 questions that were derived from an extensive review of past relevant books and articles in the philosophy and science literature. These questions spanned a broad range of topics, several of which are beyond the scope of our current discussion (questions on extrasensory perception, out of body experiences, reincarnation, etc.). Of the respondents, 56% held a doctorate degree, and 32% were presenters at the conference. The authors concisely summarized the results by noting that there was roughly a ‘tripartite division’ among the participants: one third were materialists, one third were ‘extraordinarily transcendent’, and a third were ‘conservatively transcendent’ (*ibid.*, p. 494). The second related survey, including many professionals, especially in medical fields, was given to 1,850 mainly European adults attending meetings on consciousness (Demertzi *et al.*, 2009). This is the same survey form as that given to the UK university students that we described above. In this case roughly 40% of respondents would be classified as dualists, while 39% would be classified as materialists. The results of these two previous surveys suggest that many professionals and researchers involved or interested in consciousness studies do not fit what would be predicted by the second claim of the complementary beliefs hypothesis — i.e. they are not almost all materialists.

The Problem of Other Minds

The difficult ‘problem of other minds’ is that we can only directly experience our own mind, leaving it unclear as to how we can know

between those responding ‘yes’ and those responding ‘no’, regardless of a student’s gender (Adeberg, Thompson and Nahmias, 2014).

that other people actually have a mind, since all we can do is observe their behaviour (Searle, 2004). How do we know that others are not ‘philosophical zombies’? While in everyday life most people seem to resolve this issue, perhaps via analogy to themselves and inference to the best explanation, the real issue concerns how this is done. At the present time there does not appear to be a clear agreement in the literature on how to resolve the philosophical or scientific versions of this problem, making it ‘one of the central challenges for the science of consciousness’ (Bayne, 2009) and a key factor in why there are so many diverse theories of consciousness (Katz, 2013). The results from our survey reported above provide substantial empirical data that document how people address this issue in their daily lives, or at least the consciousness aspects of the problem. Not surprisingly, we found that 99% of respondents to our survey believe that other people are conscious, consistent with past statements that the vast majority of people are not solipsists (Bayne, 2009).

Historically, discussion surrounding the problem of other minds has focused primarily on other *human* minds. The problem becomes much more challenging when one considers whether animals or machines have minds and are conscious. In the case of animals, specific behavioural and neurobiological criteria/evidence for animal consciousness have been suggested, and efforts have been made to distinguish between conscious and unconscious species (Edelman, Baars and Seth, 2005; Griffin and Speck, 2004; Varner, 1998). While it remains controversial today whether animals have phenomenal consciousness, it has been suggested that ‘there is broad, common-sense agreement that phenomenal consciousness is more likely in mammals and birds than it is in invertebrates’ (Allen and Bekoff, 2007), with other intermediate species such as fish forming a ‘grey area’. Our survey results are consistent with this conjecture: in answering the second question, fully 86% of our respondents indicated that at least some animals are conscious, while 56% indicated that they considered all animal species that we listed, including fish, ants, and worms, to be conscious. Interestingly, 18% of respondents indicated that even trees are conscious. While the notion that plant life is conscious may strike some as surprising, there is growing scientific evidence that plants do ecologically-relevant information processing and communicate with one another via chemical signals, e.g. some plant species can ‘hear’, discriminate, and respond appropriately to sounds that indicate a threat (Appel and Cocroft, 2014). This has contributed to a substantial literature, online discussions, and media

coverage about plant consciousness and intelligence that may have influenced our respondents (Cvrckova, Lipavska and Zarsky, 2009; Marder, 2012; Nagel, 1997; Trewavas, 2003).

Several past studies have also examined how people attribute consciousness to different entities. A recent survey of 34 university students examined how they attributed phenomenally conscious experiences (feels happy, feels pain, etc.) to four types of entities: insects, plants, vehicles, and naturally-moving objects (Arico *et al.*, 2011). These four entities roughly correspond to the rightmost portion of our ordered list of physical entities (see Figure 2 above). This previous survey was assessing whether the attribution of consciousness was primarily due to the presence or absence of agency in an entity. The main result of the study was that students attributed conscious mental states much more frequently to insects (70%), which were viewed as agents, than they did to non-agent entities such as plants, vehicles, and naturally-moving objects (10% or less in each case). While it is difficult to compare these results to ours because of the differing methodology, they are roughly in agreement with our findings of how students attributed consciousness to entities (Figure 2). However, our results appear inconsistent with the Arico *et al.* hypothesis that simple agency is necessary and sufficient for attributing consciousness to another entity, since a sizeable portion of our subjects did not attribute consciousness to ants, fish, and other animals. Our results are thus more consistent with a previous competing hypothesis that agency and subjective experience are two separate aspects of how people attribute mental properties to various entities (Gray, Gray and Wegner, 2007).

Also related to our work is evidence from a past empirical study showing that, while they may not know the technical terminology, many non-philosophers understand the concept of phenomenal consciousness in the same way as trained philosophers do (Knobe and Prinz, 2008). However, this study has been criticized on methodological grounds, and additional evidence has been presented that some non-philosophers intuitively conceive of phenomenal consciousness (subjective experience) and qualia in different ways than philosophers do (Sytsma and Machery, 2009; 2010). Some of the conclusions of these latter studies are controversial (Sytsma, 2010; Sytsma and Machery, 2012; Talbot, 2012).

The problem of other minds is also a fundamental issue in the context of increasing research related to machine consciousness (Reggia, 2013). This issue arises, for example, in the context of neurocognitive systems that use associative processes as a basis for reporting internal

perceptions such as unpleasant stimuli (Haikonen, 2012), that can pass the mirror test of self-recognition (Takeno, 2013), and that can exhibit cognitive control (Reggia, Monner and Sylvester, 2014). Work in this field has also produced a number of proposals stating specific criteria for deciding whether or not a machine is conscious (briefly reviewed in Reggia, 2013). These criteria generally differ in spirit from the classic Turing Test, or other similar tests based solely on behavioural criteria, in that they depend in part on a machine's internal information processing mechanisms. While a large majority of respondents to our survey indicated that computers are not conscious, surprisingly (to us) about 3% indicated that they believed computers are conscious while another 15% were uncertain.⁶ Also, about 3% included thermostats among conscious entities. We could not locate any previous surveys asking individuals to indicate whether or not machines are conscious, but there has been one informal survey of senior AI researchers that is relevant (McDermott, 2007). This survey asked a single multiple-choice question regarding how one would characterize the problem of creating a computer or program having phenomenal consciousness. Emailed to 207 individuals, 34 responded. Roughly, 50% of respondents were optimistic that AI researchers would eventually solve this problem (although some felt it would require new ideas), 26% felt the problem is too ill-defined or only apparent, or that AI had nothing useful to say about it, while 24% did not agree with either of these possibilities or felt the problem was uninteresting. In the context of our current discussion, the key point of these results is that not a single respondent indicated in the comments section that they had any disagreement with the implicit assumption of this survey that current machines are not conscious. Together with the results of our own survey, it seems clear that the vast majority of people view contemporary computers as being unconscious.

Conclusions

The results of our survey, combined with the earlier related surveys that we summarized, cannot definitively disprove the complementary beliefs hypothesis. However, a few conclusions seem to be evident. First, no existing survey of opinions concerning the nature of

⁶ Out of 184 respondents. As noted earlier, the question about computer consciousness was not included the first time the survey was used. It was added to subsequent versions when post-survey discussion indicated that some students were conflicted on this issue.

consciousness, including the current one, provides evidence that supports the complementary beliefs hypothesis. Second, while all of these surveys are quite limited and their detailed results vary, they consistently show that there is a wide range of philosophical viewpoints concerning the fundamental nature of consciousness, regardless of what population is being surveyed. Thus, early university students include many materialists, while a significant number of individuals that can be considered to be professionals interested in consciousness studies appear to accept dualism. This latter point is consistent with the broad range of viewpoints and controversy in the existing literature on consciousness. Third, and perhaps most surprising to us, there appears to be a small but significant number of idealists, at least among young adults, something that was unanticipated by us.

With respect to the problem of other minds, a fourth conclusion is merited: there is a remarkably broad range of beliefs about which entities are conscious. These beliefs vary from panpsychism to denying that any entity is conscious, including oneself. Almost all people tend to attribute consciousness to other people (solipsism is rare), while the vast majority of people attribute consciousness to at least some animals. A large majority of individuals believe that contemporary computers are not conscious, but this belief is not universal, at least among young adults.

For the future, there would be substantial value in expanding the scope of this and past surveys to include non-western cultures, although our small survey of Taiwanese students did not provide any surprises. It would also be useful to conduct longitudinal studies involving follow-up assessments of student beliefs and to examine how teaching people about the historical controversies surrounding consciousness impacts their beliefs (i.e. before and after surveys). To definitively refute/confirm the complementary beliefs hypothesis, it would be necessary to survey: 1) a more diverse population (with respect to age, education, major, culture, etc.; for example, only 6% of our survey participants were in the humanities), not just university students as was done in this and some past surveys, and 2) academic faculty in philosophy, AI, neuroscience, cognitive science, and related fields. Given the statements made by consciousness researchers in the literature (see Introduction), surveying academic faculty beliefs would need to be done anonymously in order for the results to be credible.

While we tried to make our survey questions unbiased, it is conceivable that the wording used might have influenced subject responses. For example, in the prompt for dualism, could using the

terms ‘spirit’ or ‘soul’ have discouraged some students from responding more favourably to dualism, or, on the contrary, could asking whether there is a difference between body and mind be so non-specific that it biased some students to respond favourably to dualism? Issues like this clearly merit future study. Developing a deeper understanding of the relationship between dualism and free will is also an important direction for investigation (Nahmias *et al.*, 2004), and work is already underway in this direction (Nadelhoffer *et al.*, 2014). Finally, our results concerning the attribution of consciousness to other people, animals, and computers need to be confirmed in additional settings, and further studies investigating why people attribute the presence of other minds to various animal species and computers as they do would be especially helpful at this point in time.

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APPENDIX A: Survey*Verbal Instructions:*

During our final few minutes today, we are going to do a very short written exercise. Our next class is going to be on the topic of strong AI, which increasingly has focused on the concept of machine consciousness. The nature of consciousness, and whether or not a machine can possess it, are very controversial topics. For that reason, we are asking you to give your opinion on these issues prior to our discussion by answering the three questions on this survey. You may find answering them to be difficult, but please do the best you can to provide honest answers. Do not write your name on the survey — it is to be completely anonymous and will not in any way affect your grade. I will tabulate the results and convey these to you as part of our discussion in the next class. When you are done, please hand in your answers and you are free to go.

*Survey Form:***Issues Related to Artificial Consciousness**

1. Below is a list of three statements about the human mind and how it relates to the brain that are intended to represent mutually exclusive viewpoints. To indicate which of these positions seems most like your own personal beliefs, rank each statement on a scale of 1 (very improbable) to 10 (very probable).

___ There are two realms of existence, the physical (your body, brain, and external world) and the mind, the latter being a non-physical/non-material spirit or soul.

___ There is just one primary reality: the mental; the physical world is probably an illusion created by our mind.

___ There is just one primary reality: the physical; the mind is just physical/functional properties of the brain and has a scientific explanation.

2. Draw a single vertical line separating the entities listed below that you believe are probably conscious (sentient, have subjective experiences, etc.) from those you believe to not possess consciousness:

yourself other monkey dog squirrel fish ant or tree thermostat rock
people worm

3. Do you believe that contemporary electronic computers are conscious?

___ yes ___ no ___ not sure/don't know

APPENDIX B:
Tests of Statistical Significance and Correlations

	All	Undergrads	Graduates
D > I	t(227)=9.90 p<0.01	t(168)=10.66 p<0.01	t(58)=2.04 p=0.02
M > I	t(227)=11.92 p<0.01	t(168)=10.83 p<0.01	t(58)=5.41 p<0.01
M ≠ D	t(227)=1.44 p=0.15	t(168)=0.24 p=0.81	
M > D			t(58)=3.41 p<0.01

Table B.1. The statistical significances of how philosophical views are rated differently (paired t-test; D = Dualism, M = Materialism, I = Idealism).

Dualism	t(226)=3.02 p<0.01
Idealism	t(226)=2.08 p=0.04
Materialism	t(226)=2.02 p=0.04

Table B.2. The statistical significances that undergraduate and graduate students rated differently in each philosophical view (two-sample t-test).

	All	Undergrads	Graduates
D > I	t(227)=9.09 p<0.01	t(168)=9.65 p<0.01	t(58)=1.66 p=0.05
M > I	t(227)=10.96 p<0.01	t(168)=9.43 p<0.01	t(58)=5.65 p<0.01
M ≠ D	t(227)=1.46 p=0.14	t(168)=0.43 p=0.67	
M > D			t(58)=4.09 p<0.01

Table B.3. The statistical significances of how philosophical views are rated differently after normalization (paired t-test; D = Dualism, M = Materialism, I = Idealism).

Dualism	t(226)=3.88 p<0.01
Idealism	t(226)=1.87 p=0.06
Materialism	t(226)=2.58 p=0.01

Table B.4. The statistical significances that undergraduate and graduate students rated differently, after normalization, each philosophical view (two-sample t-test).

D > I	t(10)=2.1 p=0.03
M > I	t(10)=2.49 p=0.02
M > D	t(10)=0.73 p=0.24

Table B.5. The statistical significances of how philosophical views are rated differently by Taiwanese students (paired t-test; D = Dualism, M = Materialism, I = Idealism).

All			
	Dualism	Idealism	Materialism
Dualism	+1.000	-0.057	-0.509
Idealism	-0.057	+1.000	-0.084
Materialism	-0.509	-0.084	+1.000

Undergrads			
	Dualism	Idealism	Materialism
Dualism	+1.000	-0.099	-0.521
Idealism	-0.099	+1.000	+0.039
Materialism	-0.521	+0.039	+1.000

Graduates			
	Dualism	Idealism	Materialism
Dualism	+1.000	+0.108	-0.425
Idealism	+0.108	+1.000	-0.455
Materialism	-0.425	-0.455	+1.000

Table B.6. Correlation matrices for ratings in Question 1.