

Science in the Making: Right Hand, Left Hand. II: The duck–rabbit figure

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The BBC television programme *Right Hand, Left Hand*, broadcast in August 1953, showed a version of the duck–rabbit figure and asked viewers to say what they could see in the “puzzle picture”. Nearly 4,000 viewers described the image, and the answers to those questions have recently been found and analysed. The programme probably used the same version of the figure as appeared in Wittgenstein’s *Philosophical Investigations*, which had been published a month or two previously. Although Dr Jacob Bronowski, the presenter of the programme, had suspected that left- and right-handers might differ in their perception of the figure, since they might scan it from different sides, in fact there is no relationship in the data between six measures of lateralisation and a propensity for seeing a duck or a rabbit. However the large data set does show separate effects of both age and sex on viewing the figure, female and older viewers being more likely to report seeing a rabbit (although a clear majority of viewers reported seeing a duck). There was also a very significant tendency for female viewers to use more typical descriptions of the duck, whereas males used a wider variety of types.

Keywords: Ambiguous figures; Duck–rabbit figure; Handedness; Lateralisation; Scanning.

An unusual feature of the 1953 BBC television programme *Science in the Making: Right Hand, Left Hand*, which was described in detail in our previous paper (McManus et al., 2010 this issue), was the inclusion, at the end, of a version of the duck–rabbit figure.

The duck–rabbit figure is now one of the most famous of visual phenomena, appearing in a host of introductory psychology textbooks,

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the earliest of which we are aware being Yerkes (1911, p. 271). It also occurs in many other situations where popular science is being presented, such as introductory and expository books—e.g., Jonathan Miller’s *Darwin for Beginners* (1986, p. 8)—as well as in Christmas crackers and cereal packets (ICM, the first author, even has a pack of playing cards from the 1980s advertising Kellogg’s “Raisin Splitz”, each card of which has a different visual phenomenon, with the Queen of Hearts being the duck–rabbit figure). Recently, at an interdisciplinary conference, the psychologist Stephen Kosslyn wished to explain psychological testing to the Dalai Lama, and chose the duck–rabbit figure for the demonstration (Barinaga, 2003). A history of the duck–rabbit figure by John F. Kihlstrom can be found on the Internet (Kihlstrom, 2005). Although often referred to as an illusion, as Kihlstrom points out the duck–rabbit figure is actually an ambiguous, reversible, or bi-stable figure.

The duck–rabbit figure first appeared in the bottom right-hand corner of a page of the humorous German magazine *Fliegende Blätter*¹ on 23 October 1892 (p. 147), without any attribution (Figure 1a) (Kihlstrom, 2005).² It was captioned “*Welche Thiere gleichen einander am meisten?*” (Which animals are most like each other?), and underneath it said “*Kaninchen und Ente*” (rabbit and duck). A month or so later the figure appeared in *Harper’s Weekly* (19 November 1892, p. 1114), where it had become slightly more horizontal (Figure 1b). Seven years later the figure was used by the psychologist Joseph Jastrow (Blumenthal, 1991), who describes “the ingenious conceit of the duck–rabbit”. The figure was once again somewhat redrawn and was now almost completely horizontal (see Figure 1c), first in an article in a popular science magazine (Jastrow, 1899), and then in a book (Jastrow, 1900). As Jastrow (1899, p. 292) points out:

When it is a rabbit, the face looks to the right and a pair of ears are conspicuous behind; when it is a duck, the face looks to the left and the ears have been changed into the bill. Most observers find it difficult to hold either interpretation steadily, the fluctuations being frequent, and coming as a surprise.

¹ Gombrich (1960) refers to *Die Fliegenden Blätter* whereas Kihlstrom refers to *Fliegende Blätter*; both are correct usage. The actual title page of the journal says “FLIEGENDE BLÄTTER” (see http://www.libraries.uc.edu/libraries/arb/ger_america/exhibits/pages/fliegende%20blatter.html) or subsequently, “Fliegende Blätter” (see http://shots.oxo.li/flyers/fliegende_blatter/pages/Dscf0442.htm). However *Die Fliegende Blätter* is incorrect usage, although it is found, for instance, at psychclassics.yorku.ca/Freud/Dreams/dreams6d.htm

² The duck–rabbit figure is not the only contribution of *Fliegende Blätter* to the classic literature of psychology. Sigmund Freud also quotes a joke from it in *The interpretation of dreams*, originally published in 1900 (Freud, 1976, p. 598): the magazine’s advice on how to catch lions was “Take a desert and put it through a sieve and the lions will be left over.”

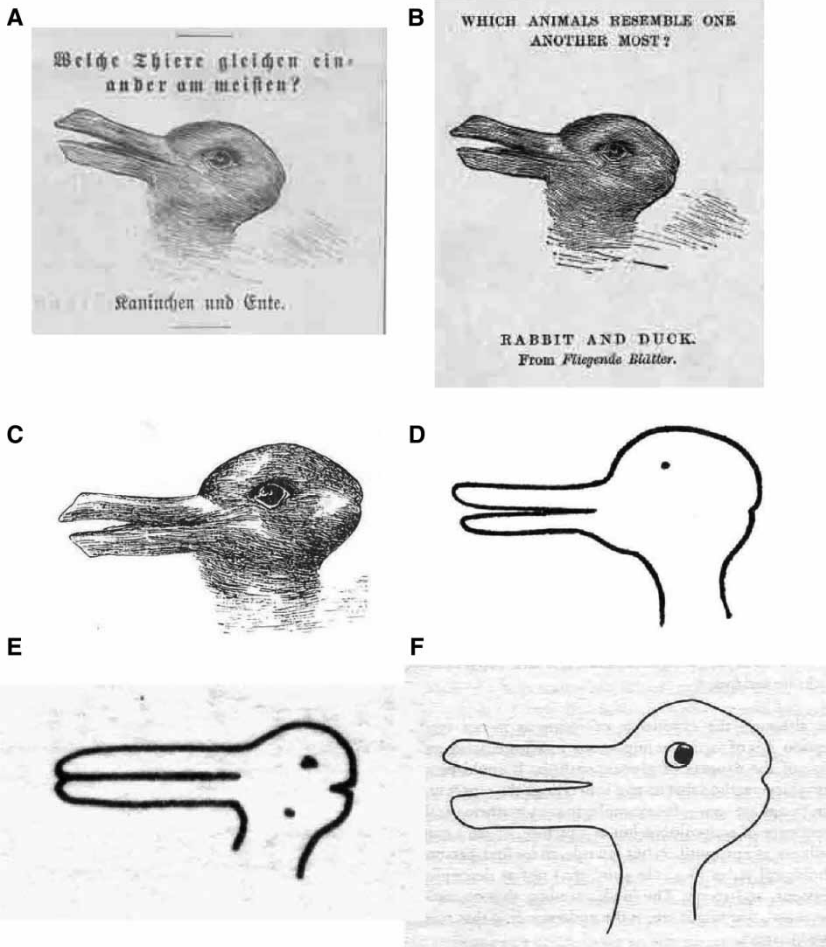


Figure 1. Drawings of the duck–rabbit figure. (a) The original drawing in the 1892 *Die Fliegenden Blätter*. (b) The version in *Harper’s Magazine* of 1892. (c) The version used by Jastrow in 1900. (d) Wittgenstein’s version in the *Philosophical Investigations* of 1953. (e) Geach’s drawing of the duck–rabbit figure from his notes for Wittgenstein’s 1946–47 lectures, for which the entire image is only 10 mm in width, and it is assumed that the tiny lower dot is an error occurring during printing. (f) The version shown in Monk’s biography of Wittgenstein and said to be that used in the 1947 lectures.

The duck–rabbit figure has been much reproduced in psychology textbooks, often being redrawn in a host of ways (see for example the 12 different versions given by Brugger, 1999). Despite being relatively well

TABLE 1
Perception of the duck–rabbit figure in relation to sex

	Males	Females	Total
Duck	1175 (66.0%)	1093 (56.9%)	2268 (61.3%)
Duck&Rabbit	242 (13.6%)	280 (14.6%)	522 (14.1%)
Rabbit	362 (20.3%)	549 (28.6%)	911 (24.6%)
Total	1779 (48.1%)	1922 (51.9%)	3701

known,³ the figure has not been used in many research papers: a search through the *PsycINFO* database in January 2006 found only 17 mentions of the figure, the first by Porter (1938), and the next, by two Georgians, occurring only in the early 1970s (Chkhartishvili, 1971; Kechkhuashvili, 1972). In contrast Jastrow’s 1899 and 1900 works have been cited 54 times since 1980 (*ISI Web of Knowledge*, Jan 2006). There are also passing mentions of the figure in earlier literature, without any source citation, as in the paper by Wever (1927).

Outside psychology, the two most well-known appearances of the duck–rabbit figure are in Wittgenstein’s *Philosophical Investigations* (1953), and Sir Ernst Gombrich’s *Art and Illusion* (1960)—see Lycan (1971) for a discussion of their intellectual similarities, although there is no mention of the specific figure itself. Gombrich uses a version of the duck–rabbit figure that, from the angle and the white blobs on the rabbit’s nose, appears to be from Jastrow (1900), although the text refers to “the humorous weekly *Die Fliegenden Blätter*” and the endnote cites Wittgenstein’s *Philosophical Investigations*. However the version used by Wittgenstein himself, which is shown in Figure 1d, is a simple line drawing, despite Wittgenstein also citing Jastrow (1899) as the source.⁴ It is clearly identical to version 2 in Brugger’s Table 1, where it is cited as coming from Rentschler, Caelli, and Maffei (1988), but those authors merely refer to “Jastrow’s duck–rabbit”. Wittgenstein first used the duck–rabbit figure in his lectures in 1947, for which Geach in his lecture

³ As an example, in 1931 the final examination paper in Psychology at University College London contained the question, “Explain how it happens that the same drawing may at one time look like the head of a duck and at another time like that of rabbit.” (E. Valentine, personal communication). The question was probably set by J. C. Flügel (who was one of the two examiners), particularly as Flügel had earlier published a paper on reversible perspective illusions (Flügel, 1913).

⁴ “I shall call the following figure, derived from Jastrow, the duck-rabbit”; “*Die folgende Figur, welche ich aus Jastrow entnommen habe, wird in meinem Bemerkungen der H-E-kopf heißen*” (Wittgenstein, 2001, pp. 165 & 165^c). In a footnote Wittgenstein simply references “Fact and Fable in Psychology”, with no date, publisher, or page number. Apparently Wittgenstein corresponded with Köhler to ascertain the source of the duck–rabbit figure (Geach, personal communication, 20 March 2006).

notes has a figure that is different from the one used by Wittgenstein himself (Geach, Shah, & Jackson, 1988; see Figure 1e), and which differs yet again from the figure describing the 1947 lectures in Monk's biography (Monk, 1990), shown in Figure 1f, which Monk has said was "based on Wittgenstein's [i.e. Figure 1d]... with 'improvements' by the design & production team at Jonathan Cape".⁵ Correspondence with Professor P. T. Geach⁶ tells us that Wittgenstein drew the duck-rabbit figure himself, in his manuscripts, and this is the one shown in Figure 1d;⁷ that experience probably underlies the comment made in a question Wittgenstein asks in a lecture in 1947 when he says, "What else happens besides the verbal description? For one thing we *copy* differently. And so: if you copy the duck/rabbit drawing and try to get the duck's expression right, you can't go on to see it as a rabbit" (Geach et al., 1988, p. 109, emphasis in original). Some further questions may be answerable if the final typescript for Part II of the *Philosophical Investigations* were available, but regrettably it has been lost, and the preliminary studies for Part II do not seem to contain any duck-rabbit figures (Wittgenstein, 1982).

Jacob Bronowski first refers to the duck-rabbit figure towards the end of *Right Hand, Left Hand*, although of course at that stage he does not refer to it by that name. He has started to explain to viewers how to complete their postcards in response to the questionnaire printed in the *Radio Times*, when he comments, as recorded in the transcript:

I want to show you how to answer the questions in a moment, but before I do so, I'd like to show you a picture, a puzzle picture. Here is a picture which has something to do with left-handedness and right-handedness. Will you look at it carefully?

This is plainly the picture of a living being, and I want you to write on the postcard, in the first place, what you think it is. I propose to say that it's an ant-eater and that I write here. Then turn your postcard this way up; look at the *Radio Times*; pick out the first question which says, 'Which hand do you write with?'. Just write the word 'WRITE'⁸ there, and put R for right. [etc].

After explaining the questionnaire, Bronowski says that the next programme will be on 12 October,

and by that time I hope that Sir Cyril Burt's team will have analysed your answers sufficiently for me to be able to give you some information about it. I'll also be

⁵ E-mail from Ray Monk, 23 January 2006.

⁶ Personal communication to ICM, dated 20 March 2006.

⁷ In an e-mail to ICM, Professor Monk commented, "I think it's quite likely that W drew it himself" (25 January 2006).

⁸ As mentioned in the previous paper, the transcript actually says "the word 'Right'".

able to tell you why the puzzle picture is connected with rightness and leftness, so let me say goodnight to you, and show you the puzzle picture for a last time – WHAT IS IT?⁹

The script is somewhat different from the transcript. This is what Bronowski was meant to say:

Just before I tell you how to fill it in, let me show you a picture. I would like you to look at it very closely. What is it. While to some people it is duck to others it is a rabbit. Actually children do make mistakes, for example for NO they say may read ON and for ON they may read NO. Some children may make mistakes between D and B for that reason, and if that does not explain ‘Mind your ps and qs’ I do not know what does. Depends on the way you look at the picture, from right to left, or from left to right. Write what you think this is on the top right hand corner of your card.

Fortunately, Bronowski avoided the error of talking about ducks and rabbits, and of mentioning right–left or left–right scanning, although he did introduce, if one may call it such, the red herring of the anteater.

At the end of the second programme on 12 October, Bronowski comments on the handedness questionnaire. He starts, however, by saying:

With that I want to leave the subject of the cold and remind you of the picture that you saw two months ago on August 14th. Do you recall this picture? Yes, it’s the puzzle picture which goes with, not exactly left-handedness or right-handedness, but with the fact that it looks different according to whether your eyes are in the habit of travelling from left to right or right to left; you see, if you look at the left side first and sweep to the right then the thing looks like a bird, because you meet the beak first, but if you’re a person who tends to look from right to left, why then it looks like a rabbit because you meet the, as it were, the front of the face first and the ears last. I would really like to have seen this trick tried out in one of those countries which reads from right to left. However, I can tell you this about our replies, and we got an enormous number of replies. They showed that this is in no way connected with left-handedness and right-handedness, but an extraordinary thing. It’s usual to find that children see this rather indifferently, and that adults are predominantly people who see it as a bird of some kind. But on this occasion we did not find that. A majority of women in fact saw it as a rabbit. I have no idea what this means and neither has anybody else. I tell it to you as one of those facts which have struck us out of the blue from the information that you’ve sent.

To our knowledge, no further analyses of the data were ever published. Neither are we aware of the origin of the comments about “children see this

⁹ Capitals in original transcript.

rather indifferently” and “adults are predominantly people who see it as a bird of some kind”. The only research paper in the literature before 1953 that mentions the figure is that of Porter (1938), and he does not seem to mention differences between children and adults. Jastrow’s version of the duck–rabbit figure is shown on p. 134 of Blau’s *The Master Hand* (1946),¹⁰ and Blau describes how “the right or left direction of viewing can each result in an entirely different picture: a duck when viewed from the left, a rabbit from the right”. It should also be mentioned that Blau cites Orton’s influential views on the role of directional scanning in reading (Orton, 1937). Kenneth Smith owned a copy of Blau’s book, now in the possession of Michael Apter, but it seems unlikely that the inclusion of the duck–rabbit figure in the programme was derived from Blau since (a) it was clearly Bronowski’s idea to include the figure, (b) Bronowski and Smith did not meet until the day of transmission, (c) the script, which was prepared earlier and without Smith’s direct involvement, clearly contains a discussion of the figure, and finally (d) Blau does not mention either sex differences or children having difficulty seeing the figure (although he does later talk about a minority of children having reading difficulties because of failure of directional scanning). Although there is no evidence that Bronowski, Smith, or Burt was aware of it—given Bronowski’s comment that “I would really like to have seen this trick tried out in one of those countries which reads from right to left”—it is of interest that only the previous year, in 1952, two papers had been published showing that the tendency to draw profile faces facing to the left is essentially similar in countries writing from left to right and right to left (Jensen, 1952a,b).

A problem for interpreting the duck–rabbit data from *Right Hand, Left Hand* is that there is no visual material from the original programme. Discussions with George Noordhof, the producer of the programme,¹¹ suggest that the duck–rabbit figure was introduced into the programme late in the production process, by Jacob Bronowski himself:

I wasn’t in agreement with it [i.e., using the duck–rabbit figure] ... I didn’t feel that it linked [but] ... Bruno wanted to show it. ... Bruno was to a certain extent interested in optical illusions ...

Bronowski had a longstanding interest in the work of Wittgenstein, and refers to both early and late Wittgenstein in his writings (Bronowski, 1956). Bronowski was an undergraduate and then a postgraduate in Cambridge

¹⁰ Interestingly the bill of the duck in this version is tilted downwards at an angle of about 10 degrees, compared with the horizontal bill in Jastrow, and the upward bills in the *Fliegende Blätter* and *Harper’s* versions.

¹¹ Interview with ICM, 4 October 2005.

from 1927 to 1934, and therefore overlapped with Wittgenstein's second stay in Cambridge, from 1929 until 1941, and it is probable that Bronowski became aware of him then. It also seemed likely to us that Bronowski's interest meant that he would have acquired the *Philosophical Investigations* soon after it was published. The exact date of publication of the book is not entirely clear, but the book was listed under "Books received" in the *British Journal for the Philosophy of Science* issue of August 1953, and in *Mind* in the issue of October 1953 (both journals publishing quarterly), as well as in the 13 August issue of the *Journal of Philosophy*, which was published fortnightly, and it was reviewed in the *Times Literary Supplement* on 28 August. Given the inevitable delays in journal publishing it seems likely that the book would have been available in June or July, when Bronowski could have read it, relatively soon before the details of the programme were finalised, but perhaps after the copy for the *Radio Times* questionnaire had been sent to press, requiring the item to be added on specially at the time of the broadcast. Professor Lisa Jardine, Bronowski's daughter who was 8 at the time the programme was broadcast, tells us (e-mail to ICM, 13 Jan 2006)¹² that she remembers her father talking about the *Philosophical Investigations*, adding:

I remember lots about my father trying out the duck/rabbit illusion on myself and my sister, and therefore recognised the Wittgenstein pic[tur]e as the one he used. I am pretty sure you are right about his seeing the image and deciding to use it.

It is perhaps worth noting that Bronowski was intrigued by the left-handedness of his daughter Lisa, who was strongly left-handed, and the only known left-hander in the family.

Subsequent investigations have revealed that Bronowski owned a first edition of the *Philosophical Investigations*, which was signed inside "J Bronowski" with "1953" written beneath,¹³ and that, as Mrs Bronowski commented to Professor Jardine: "... if you look at the volume end on (i.e., at the pages), two places in the book are darkened by use, and the book tends to fall open there. One of these is at the duck/rabbit picture."

On balance it seems therefore that we are justified in assuming that the Wittgenstein version of the duck-rabbit figure was the one broadcast on

¹² In ICM's e-mail to Jardine he had referred to the duck-rabbit illusion, and therefore Jardine replied using the same terminology.

¹³ E-mails from Mrs Rita Bronowski, 16 January 2006, and Lisa Jardine, 16-17 January 2006. Bronowski's version of the *Philosophical Investigations* was unannotated except for occasional changes in the English version (the book was printed with Wittgenstein's original German on the left-hand page and the English translation on the right). Bronowski, although born in Poland, first went to school in Germany (Bronowski, 1985).

Right Hand, Left Hand, and it was in all likelihood also the version that Bronowski showed to his daughters, probably in the days before the programme was broadcast.

Bronowski's interest in the duck-rabbit figure in relation to lateralisation clearly derives, as he says in the follow-up programme of 12 October 1953 (quoted earlier), from the possibility that the direction of visual scanning from right to left or left to right influences the perception of the figure. This idea is also related to the comment that Wittgenstein himself makes in para. 212, where he says, in an idea that anticipates the scanpath hypothesis of Noton and Stark (1971):

Imagine a physiological explanation of the experience. Let it be this: When we look at the figure, our eyes scan it repeatedly, always following a particular path. The path corresponds to a particular pattern of oscillation of the eyeballs in the act of looking. It is possible to jump from one such pattern to another and for the two to alternate.

Wittgenstein's earlier comments from 1949, on which para. 212 is based, then continue, "hence I cannot see the duck-rabbit as the picture of the head of a rabbit superimposed on the head of duck . . ." (Wittgenstein, 1982, para. 777, p. 99e).

Bronowski's subsequent comments say that the results "showed that [the duck-rabbit phenomenon] is in no way connected with left-handedness and right-handedness", although no data were ever presented to that effect. Here we will analyse the data formally, and also investigate some other aspects of the ambiguity of the duck-rabbit figure, as revealed by the responses sent on postcards by the viewers of *Right Hand, Left Hand*, broad details of which have been provided in the previous paper (McManus et al., 2010 this issue).

METHOD

Analysis was undertaken of postcards returned by the viewers of *Right Hand, Left Hand*, which was broadcast on BBC television on Friday 14 August 1953. Viewers answered 12 questions printed in a questionnaire in that week's *Radio Times*, and in addition the presenter asked viewers to write their description of the "puzzle picture", as in the transcript presented earlier. Data from the postcards were entered into a computer, with conventional statistical analyses carried out using SPSS 11.5. See the previous paper for further details of the sample etc. (McManus et al., 2010 this issue).

RESULTS

Although 6,336 postcards were found in the archive, some contained information on multiple individuals, so that data were available for 6,549 people; however not all information was available for all individuals. In particular, the answer to the question about the “puzzle picture” was provided by only 3,957 individuals. The lack of answers from the remaining 2,592 respondents probably reflects the fact that some did not see the puzzle picture, or did not see or understand Bronowski’s instructions. In addition we also know from comments on the cards that some respondents had not seen the television programme, but had still returned the questionnaire from the *Radio Times* out of interest. Of the 3,957 individuals describing the duck–rabbit figure, 3,292 (83.2%) had written a single description, 642 (16%) had written two descriptions, and 23 (0.6%) had written three descriptions.

Descriptions were coded numerically, with each novel description being given a unique code number. Descriptions were often extremely varied, with answers transcribed into the computer as written (e.g., “duck-billed platypus”, “umbrella handle”, “rabbit drawn by left-handed person”, “pipe and tobacco pouch arranged to look like a bird’s head”, or “shadow of clenched left hand holding a pencil”). A total of 114 answers suggested, as Bronowski had prompted, that the picture was an anteater.

For the first analysis of the data, all answers were coded as “duck-like” (e.g., any bird), “rabbit-like” (e.g., rabbits, hares, etc.) or “other”. Of 4,641 responses, 2,870 (72.6%) were duck-like, 1,467 (37.1%) were rabbit-like, and 304 (7.7%) were coded as other. Individuals who gave only duck-like responses were classified as “Duck”, those giving only rabbit-like responses were coded as “Rabbit”, those giving both a duck-like and a rabbit-like response were coded as “Duck&Rabbit”, and those giving only “other” responses were coded as missing. Altogether 3,701 respondents gave a non-missing answer, of whom 2,268 (61.3%) were classified as “Duck”, 911 (24.6%) as “Rabbit”, and 522 (14.1%) as “Duck &Rabbit”. A total of 256 individuals did not give any answer recognisable as a duck or a rabbit (including those who answered “anteater”). We will analyse these categories in relation to the background variables of sex, age group, and handedness.

Sex

Table 1 shows the sex of respondents in relation to their classification. A majority of both men and women saw the figure as a duck, although men were somewhat more likely to report the figure as a duck ($\chi^2 = 38.65$,

2 *df*, $p < .001$). Slightly more women than men reported both duck and rabbit.

Age

Table 2 shows the reports of participants in relation to age, which was grouped by decades. Only seven children under the age of 10 had responded (five of whom had seen the figure as a duck), and they were grouped with those aged 10 to 19. Likewise, those aged 60 or over were grouped together. There is a highly significant difference between age groups ($\chi^2 = 69.70$, 10 *df*, $p < .001$). A multiple regression of response (with Duck coded as 1, Duck&Rabbit as 2, and Rabbit as 3) on age and sex found a significant (linear) effect of age (beta = .103), $t(3684) = 6.33$, $p < .001$, and of sex (beta = .109), $t(3684) = 6.69$, $p < .001$, but no interaction of sex with age, $t(3683) = -0.609$, $p = .543$. As can be seen in Table 2, the proportion of Rabbit responses increases with age, while the proportion of Duck responses decreases with age, and the multiple regression suggests that this process occurs in a similar way in males and females.

Lateralisation

Respondents were asked six questions about their handedness and lateralisation, with responses being coded as Right, Left, or Mixed/Both. Table 3 shows the association between responses to the duck-rabbit figure and lateralisation. Writing hand did not show a significant association with response ($\chi^2 = 8.21$, 4 *df*, $p = .084$; linear-by-linear association, $\chi^2 = 1.37$, 1 *df*, $p = .242$), neither did holding a brush ($\chi^2 = 5.63$, 4 *df*, $p = .228$; linear-by-linear association, $\chi^2 = 0.152$, 1 *df*, $p = .697$), throwing a ball ($\chi^2 = 4.93$, 4 *df*, $p = .295$; linear-by-linear association, $\chi^2 = 0.138$, 1 *df*, $p = .710$), or

TABLE 2
Perception of the duck-rabbit figure in relation to age

<i>Age group</i>	<i>Duck</i>	<i>Duck&Rabbit</i>	<i>Rabbit</i>	<i>Total</i>
0-19	302 (68.6%)	45 (10.2%)	93 (21.1%)	440
20-29	671 (67.4%)	118 (11.9%)	206 (20.7%)	995
30-39	740 (60.8%)	185 (15.2%)	292 (24.0%)	1217
40-49	327 (50.5%)	120 (18.5%)	200 (30.9%)	647
50-59	137 (56.1%)	40 (16.4%)	67 (27.5%)	244
60+	83 (57.6%)	13 (9.0%)	48 (33.3%)	144
Total	2660 (61.3%)	521 (14.1%)	906 (24.6%)	3687

TABLE 3
Perception of the duck-rabbit figure in relation to lateralisation

		<i>Duck</i>	<i>Duck&Rabbit</i>	<i>Rabbit</i>	<i>Total</i>
Which hand do you WRITE with?	Right	1916 (60.8%)	454 (14.4%)	779 (24.7%)	3149
	Mixed/Both	21 (48.8%)	10 (23.3%)	12 (27.9%)	43
	Left ⁺	331 (65.0%)	58 (11.4%)	120 (23.6%)	509
Which foot do you prefer to KICK with?	Right	1674 (61.9%)	382 (14.1%)	649 (24.0%)	2705
	Mixed/Both	136 (51.1%)	52 (19.5%)	78 (29.3%)	266
	Left	458 (62.7%)	88 (12.1%)	184 (25.2%)	730
When you are brushing your teeth, which hand do you hold the BRUSH in?	Right	1743 (60.8%)	424 (14.8%)	701 (24.4%)	2868
	Mixed/Both	79 (62.7%)	17 (13.5%)	30 (23.8%)	126
	Left	445 (63.1%)	80 (11.3%)	180 (25.5%)	705
Which hand do you prefer to THROW a ball with?	Right	1789 (61.2%)	425 (14.5%)	707 (24.2%)	2921
	Mixed/Both	44 (55.0%)	13 (16.3%)	23 (28.8%)	80
	Left	433 (62.1%)	83 (11.9%)	181 (26.0%)	697
If you are winding wool or string, which hand do you HOLD the ball in?	Right	608 (62.7%)	123 (12.7%)	238 (24.6%)	969
	Mixed/Both	102 (59.3%)	32 (18.6%)	38 (22.1%)	172
	Left	1554 (60.8%)	367 (14.4%)	633 (24.8%)	2554
If you had to carry a glass with water filled to the brim, which hand would you prefer to CARRY it in?	Right	1480 (61.3%)	345 (14.3%)	589 (24.4%)	2414
	Mixed/Both	321 (63.8%)	81 (16.1%)	101 (20.1%)	503
	Left	472 (59.4%)	96 (12.3%)	220 (28.3%)	778

⁺ Includes 64 who indicated that they currently used their right hand but had used their left hand in the past.

winding a ball of string ($\chi^2 = 4.96$, 4 *df*, $p = 0.505$; linear-by-linear association, $\chi^2 = 0.444$, 1 *df*, $p = 0.505$). Kicking a ball did show a significant association ($\chi^2 = 15.58$, 4 *df*, $p = .004$; linear-by-linear association, $\chi^2 = 0.418$, 1 *df*, $p = .518$), with mix/both footers being more likely to answer Rabbit or Duck&Rabbit. Carrying a glass of water also showed an association with response ($\chi^2 = 12.67$, 4 *df*, $p = .013$; linear-by-linear association, $\chi^2 = 1.40$, 1 *df*, $p = .238$), with mixed/both responders less likely to answer Rabbit. Since lateralisation correlates with age ($r = -.241$, $p < .001$), older respondents being less likely to be left-handed, the effects of lateralisation on duck-rabbit response were assessed by multiple regression, with duck-rabbit response as the dependent variable, and first taking age and sex into account. None of the six measures of lateralisation showed a significant prediction of duck-rabbit response, with the lowest of the p values only being .180.

TABLE 4
 Typicality scores of respondents with Duck, Duck&Rabbit, and Rabbit responses

	<i>Duck</i>	<i>Duck&Rabbit</i>	<i>Rabbit</i>	<i>Total</i>
Mean(log ₁₀ (tokens))	2.011	2.497	2.905	2.300
SD(log ₁₀ (tokens))	.924	.657	.502	.890
<i>N</i>	2268	522	911	3701

Typicality of particular duck-like and rabbit-like responses

Thus far the analysis has concentrated on responses grouped in the traditional way as duck, rabbit, or both. However the method of data collection meant that there was a wide range of answers actually given. This was particularly striking for the duck-like responses, which included far more specific ornithological identifications, including, for instance, “seagull”, “gannet”, “cormorant”, “pelican”, “puffin”, “oystercatcher”, “heron”, “snipe”, “emu”, “dodo”, “kiwi”, “dunlin”, “flamingo”, etc. We therefore wished to look at the variation in responses, and assess the factors affecting it.

A typicality index was calculated by first grouping together all responses that seemed to be directly equivalent (taking account of spelling errors, equivalences such as “duck” and “duck’s head”, etc.). A total of 274 different response types were found. The number of tokens of each type was then calculated. The 10 most-used types had frequencies of 1266 (“Rabbit”), 818 (“Duck”), 605 (“Bird”), 173 (“Seagull”), 170 (“Hare”), 164 (“Bird’s head”), 129 (“Long/large billed/beaked bird”), 114 (“Anteater”), 94 (“Emu”), and 67 (“Duck-billed platypus”), with 171 types occurring only once, so that the median token frequency was 1, whereas the mean was 16.95 and the standard deviation was 99.54. Since the distribution is extremely skewed, and similar to a Zipf distribution, the logarithm to the base 10 of the token frequency was used as a measure of how often a particular type occurred. In passing it should be noted that log₁₀(tokens) correlates 0.963 with normal scores calculated on the token frequencies score using the procedure in the SPSS RANK program

A typicality index was calculated for each respondent as log₁₀(tokens), which for respondents giving two or three answers was the more unusual (i.e., lower) of the scores. Respondents with Duck responses had lower typicality scores than those with Duck&Rabbit responses, who in turn had lower typicality responses than those with Rabbit responses (see Table 4). One-way ANOVA confirmed the differences, $F(2, 3698) = 420.4$, $p < .001$, with all sub-groups being different from one another on a Scheffe post-hoc comparison. Examination of the data showed that although in particular there were many different ornithological terms used for the duck, there were

few alternatives for the rabbit, these being restricted to terms such as “hare”, “shadow rabbit”, “walking stick in shape of rabbit’s head”, “frightened long-eared rabbit”, and “rabbit head upside down”. The remainder of this analysis is therefore restricted to respondents giving only a duck-like answer.

Influence of sex, age, and laterality on types of responses

A multiple regression was carried out in which \log_{10} (typicality) of a duck-like response was used as the dependent variable, and sex, age, and laterality were entered at successive stages. The effect of sex was highly significant, $t(3925) = 5.38$, $p < .001$, at the first step. Age was entered as linear and quadratic effects, which were jointly highly significant, $F(2, 3923) = 9.07$, $p < .001$. At the next two steps the linear age \times sex and the quadratic age \times sex interactions were added, although neither was significant, $t = -1.690$ and $.187$ respectively. Finally each of the six laterality measures was entered, and none achieved significance. Figure 2 shows the joint effects of sex and age on the typicality of the duck-like responses, and it is clear that at all ages women have more typical answers than do men, with younger and older respondents having less typical responses than those in the middle of the age range.

DISCUSSION

Although the duck-rabbit figure is a popular feature in many introductory psychology (and philosophy) courses, there is a surprisingly small amount of serious research into it, and most that has been done uses relatively small sample sizes. The present study, with its large sample size and its population with a wide range of ages, is therefore unusual in its own right. It is also unusual for having been carried out over 50 years ago and only now being analysed.

The duck-rabbit was clearly incorporated into the BBC television programme *Right Hand, Left Hand* at the last moment, primarily because the polymathic presenter, Dr Jacob Bronowski, had an interest in philosophy, and had just read Wittgenstein’s newly published *Philosophical Investigations*. Wittgenstein had himself talked about the possibility of scan patterns having a role to play, and Bronowski decided to test that hypothesis, albeit indirectly, by comparing the responses of right- and left-handers to the duck-rabbit figure.

The duck-rabbit figure was presented at the end of the programme as a “puzzle picture”, and nearly 4,000 people described what they thought they had seen. Although well known now, it is likely that the figure was much less in the public eye in 1953, and certainly many of the respondents answered

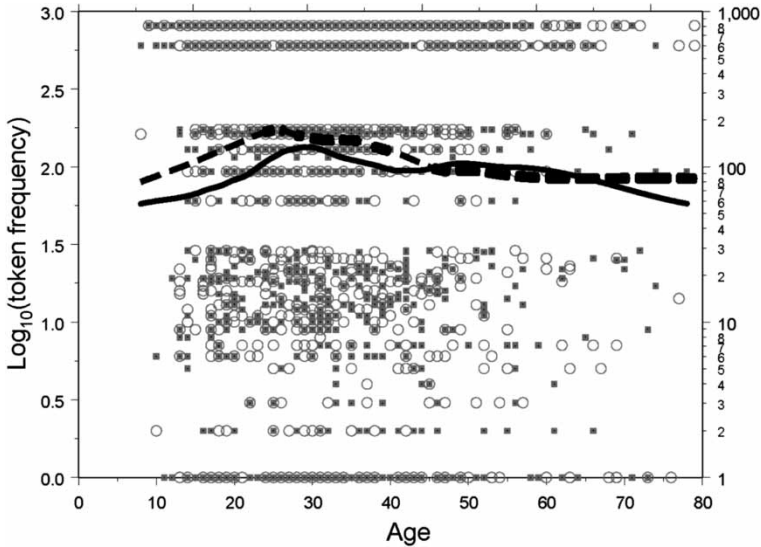


Figure 2. Typicality of response of individuals who gave duck-like responses in relation to age. Left-hand axis shows $\log_{10}(\text{typicality})$, and right-hand axis (on a logarithmic scale). Males are shown as small, solid square points and a solid black line, and females as open circles and a pale grey line. Fitted lines are loess curves (locally weighted least square lines, which are in effect a non-parametric form of regression).

with terms other than “duck *and* rabbit”. Bronowski speculated in the second programme in the series that the duck–rabbit figure “looks different according to whether your eyes are in the habit of travelling from left to right or right to left”. Although there has been little research on the topic since, there are at least hints that some people have a characteristic pattern of eye movements (Zangemeister, Sherman, & Stark, 1995), and that lateral saccadic eye-movements may differ to some extent in right- and left-handers (Hutton & Palet, 1986). There is also a suggestion that eye-movements are related to the spontaneous reversals of the Necker Cube, another well-known ambiguous figure (Ellis & Stark, 1978).

Bronowski had no direct measure of eye movements; instead he assumed that right- and left-handers differed in the direction of scanning patterns, and there is some evidence to suggest that might be the case, at least in part. Right- and left-handers differ, at least in a statistical basis, in the direction in which they draw profiles (Albers & Suchenwirth, 1979; De Agostini & Chokron, 2002; Hammer & Kaplan, 1964; Mäki, 1928; Scheirs, 1990), or circles (Van Sommers, 1984), and they also show different directions of spontaneous rotation (Ruisel, 1973; Bracha, Seitz, Otemaa, & Glick, 1987), although there are large individual differences, and of course motor

asymmetries related to handedness may not reflect perceptual asymmetries. However, it is feasible that right and left-handers might have shown differences in their perception of the duck-rabbit figure. But as Bronowski admits in the second programme, there is no evidence of any effect of handedness at all.

What is not at all clear about the programmes and the analysis is the extent to which the postcards were analysed in 1953. The cards do contain a few marks in red pen, which are thought to have been made by Charlotte Banks, the research assistant to Professor Cyril Burt, who was charged with analysing the data. One set of numbers, which consists entirely of 1s, 2s, and 3s, corresponds almost exactly to our classification of duck-like, rabbit-like, and mixed duck and rabbit responses, and are present on 3,617 cards, suggesting that Banks had been through the entire set of cards coding the responses. However, whether a formal cross-tabulation by sex and handedness had been carried out is less clear. In particular, Bronowski comments in the second programme that “A majority of women in fact saw it as a rabbit”. As has already been seen in Table 1, the majority of women in fact saw the figure as a duck, although there was a statistically higher proportion of women who answered “rabbit” (and in passing it is worth noting that the present large sample size allows the effect to be found, even though Brugger’s smaller 1999 study suggests there is no sex difference). The comment about children is also confusing, but it is clear in the current data that even if there is a slightly higher proportion of younger people who see the figure as a duck, there is no evidence of younger respondents not seeing the duck and/or the rabbit in the figure. It is possible that Banks presented subtle statistical differences to Bronowski, and that these subtleties got lost and resulted in an erroneous result being presented. If so, it is surprising that Banks never published the result of what must have been a tedious analysis without computer assistance. More likely is that Banks classified the cards into three response groups, but that there was not then time to carry out the cross-classification: a sample, perhaps non-randomly chosen, was analysed, and it gave an erroneous result.

What is undoubtedly a robust result is that there is no association with direction of lateralisation in these data, as Bronowski said. In some ways that is surprising, and it is reassuring to be able to put the result securely into the scientific literature. Whether Bronowski had robust evidence for his conclusions at the time is another matter, but he was undoubtedly correct.

A striking feature of the present data is the predominance of duck responses—nearly two and a half times as many as rabbit responses. That result is consistent with the findings of Brugger (1999) who found the Wittgenstein figure to be one of the most duck-like of the figures. Even small differences in contour, in the position of the eye, and in the inclination of the beak/ears seem to influence the dominance of perception of duck or rabbit,

and it is clear that the Wittgenstein figure is very biased towards the duck. Analysing the reasons for that are not easy given the present data, but one possibility is that most individuals, regardless of handedness, tend to scan from left to right (see, for instance, Ebersbach et al., 1996, who suggest that initial visual exploration usually begins on the left). That may of course be secondary in part to reading direction (Chokron, Bartolomeo, Perenin, Helft, & Imbert, 1998; Dobel, Diesendruck, & Bölte, 2007; Fagard & Dahmen, 2003), or perhaps to a bias in perception of forward-facing motion (which has been suggested to relate to perception of the duck–rabbit figure; see McBeath, Morikawa, & Kaiser, 1992), but even so, as one referee pointed out to us, it should still mean that the more duck-like Wittgenstein figure should be seen more as a rabbit when laterally reversed, as in Figure 3. To our eye it does not, primarily looking like a duck either way, but that would benefit from formal testing.

Brugger (1999, p. 976) makes the interesting comment that across 12 different versions of the duck–rabbit figure, “the bird was significantly more easily identified than the rabbit”, which he then goes on to speculate, as in a previous study (Brugger & Brugger, 1993), may be “an effect possibly due to the larger category size for birds compared to rabbits”. The unusual nature of Bronowski’s instructions, which atypically did not mention either duck or rabbit, allowed us to assess the range of answers given, and it was clear that

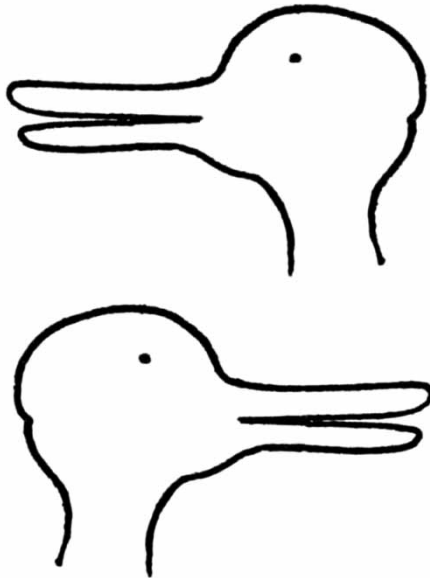


Figure 3. Wittgenstein’s version of the duck–rabbit figure in its original orientation (top) and mirror-reversed (bottom).

while the duck can be seen as very many different types of bird, the rabbit is far more restricted, essentially being seen as a rabbit or a hare, supporting Brugger's hypothesis. The typicality of duck responses was greater in females than in males (i.e., they used a smaller range of bird names), and it was also females who were more likely to report having seen a rabbit, which is consistent with Brugger's prediction. Brugger also suggested to us, while reviewing the present study, the interesting possibility that the age effect, whereby younger viewers were more likely to see the figure as a duck, might reflect the popularity of the cartoon figure Donald Duck, which was at its zenith in the 1940s and early 1950s—an effect similar to the increased popularity of the rabbit interpretation that occurs before Easter (Brugger & Brugger, 1993).

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