

The Mathematics of Self-Deception

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Clever Hans
performing a
"Mathematical
feat"

¹ Excluding Mr. Ed, the talking horse of situation-comedy fame, the most celebrated equine intellect was Clever Hans, the turn-of-the-century trotter who, even without benefit of a TV voice-over, managed to dazzle spectators with his brilliance. The nine-year-old Hans, who was "taught" for half a decade by William von Osten, a retired German schoolteacher, meteorically rose to stardom during the summer of 1904. Each day at noon in a quiet courtyard in northern Berlin, the horse performed intellectual feats before a select company of psychologists, naturalists, educators, political dignitaries and even the kaiser himself. EQUINE PRODIGY KNOWS MUSIC AND ARITHMETIC trumpeted a headline from the *New York Times*. BERLIN'S WONDERFUL HORSE: HE CAN DO ALMOST EVERYTHING BUT TALK proclaimed the title of the follow-up story.

² To answer a numerical problem, Hans would

paw the ground with his hoof the appropriate number of times. He spelled words in a similar way, representing each letter by a certain number of pawings. Hans also communicated by shaking his head "yes" or "no" and by picking up objects with his teeth.

³ "Besides adding, subtracting, multiplying, and dividing sums," the *Times* reported, "[Hans] does expressions involving several of these operations, finds square numbers, and not only simply repeats what is taught, but solves fresh problems put to him in the absence of his master, showing a grasp of the principles of arithmetic. The stallion also forms little sentences, remembers them the next day, and discriminates twelve colors and shades, giving their corresponding names. Moreover, he distinguishes musical tones, indicating where they are situated on the chromatic scale, and picks out discords, designating which tone to omit in order

to restore harmony. . . . Professor von Osten affirms that the horse is as well educated as a boy who has gone to school for the same number of years. . . .”

⁴ Although scores of astute observers witnessed Hans’s mental prowess, none could explain it. In the interests of science, Von Osten opened his house and stable to a commission of eminent psychologists from the University of Berlin who subjected the perspicacious steed to a grueling month of tests. They also reviewed the method Von Osten used to teach Hans: Repeat a question again and again until the horse answers it correctly. Do not punish wrong answers but reward correct ones with a carrot, a piece of bread, or a lump of sugar.

⁵ While the psychologists probed Hans, his reputation as an intellectual heavyweight made him an international celebrity. He became the subject of popular couplets, and his name was sung on the vaudeville stage. Postcards and beverage labels were emblazoned with pictures of his brainy head. Children played with toys that bore his likeness. The expression “horse sense” took on new meaning.

⁶ The commission of psychologists reached a curious conclusion, which made front-page newspaper copy the world over: “The horse Hans does not think, but at the same time there is no trickery on the part of his trainer.” The psychologists found that Hans could answer a question only if someone within his line of sight knew the answer. The people around Hans, it turned out, unknowingly cued the animal in very subtle ways, through barely perceptible movements and vocal signals.

⁷ Those who questioned the horse, for example, tended to incline their head slightly toward him as they watched him slowly paw out the answer to an arithmetic problem. When Hans had pawed the ground the right number of times, the questioners would unintentionally raise their head a fraction of an inch—unconsciously expecting (or hoping) that Hans was finished. Observing the raised heads, Hans would stop pawing. This explanation was verified by the psychologists deliberately elevating their head at a premature point (Hans would then stop) and their purposely keeping their head bent (Hans would then paw *ad tedium*). Moreover, if they did not initially lean toward Hans, he would not start pawing at all.

⁸ The psychologists asserted that even Von

Osten did not know that he was subtly cuing Hans—and subsequent investigations have confirmed that he was not a con man. The cues, of course, were not fail-safe. So firmly did Von Osten believe in Hans’s intelligence that when the horse gave a wrong answer, because of a cuing error or otherwise, he would attribute it to Hans’s cantankerous temperament or his short attention span. Von Osten’s faith in Hans was not shaken even by the publication of the psychologists’ findings. He angrily denied them and spirited the horse away from further experimentation.

⁹ Eighty years later, Clever Hans is still part of our scientific vocabulary. To claim that an experiment is poisoned by the “Clever Hans effect” is to accuse the researcher of unknowingly influencing the response of his subjects.

¹⁰ Today, the specter of Clever Hans haunts investigators who are trying to establish the existence of extrasensory perception. In a typical test of mental telepathy, the experimenter uses a special 25-card deck, in which each card has one of 5 symbols printed on it and the deck as a whole consists of 5 cards of each symbol. The experimenter draws a card, looks at it, concentrates on the symbol and asks the subject to use his mind-reading powers to guess the symbol. Then the card is put aside, another card drawn from what remains of the deck, and the experiment repeated. In this manner, the whole deck is run through a card at a time.

¹¹ If the subject is not telepathic, how many cards should he guess correctly on the average? Since the symbols are equally likely to arise, he is expected to get 5 of the 25 cards right. This expectation, however, will be fulfilled only in the long run—after the deck has been gone through numerous times and the results averaged. After many trials, the experimenter is apt to regard even slight deviations from an expectation of 5, say 5.1, as evidence of ESP. (Partisans of the paranormal might be equally excited by a result of 4.9. “Ah! Brain waves are being received but read incorrectly.”)

¹² Although few ESP investigators are as blatantly dishonest as Dr. Venkman (Bill Murray) in *Ghostbusters*, who tells the ingenue whose telepathic powers he’s testing that she’s made a correct guess even when she hasn’t, many bias their experiments in subtler ways. Conveniently invoking the grounds that the subject may need to calibrate brain waves

to local conditions, some experimenters deliberately provide feedback after each guess. They may tell the subject what the card was (complete feedback) or they may tell him whether he was right or wrong (partial feedback). If the subject subsequently exploits this information in a purely statistical way, the expectation value will be skewed—and an ignorant experimenter may well suspect telepathy where Lady Luck is the real culprit. For example, in the case of complete feedback, the subject can always name the last card by process of elimination.

¹³ Sage experimenters know that they must adjust the expectation value to account for intentional feedback, but the mathematics is so complex that they may not know how to compute the adjustment. A more pernicious problem is the Clever Hans phenomenon. A naive experimenter may smile or nod in recognition of correct answers or, in full view of the subject, note correct and incorrect answers on a pad of paper. If the experimenter doesn't know that he's giving feedback, he can hardly begin to compute its effect.

¹⁴ So it appears that Clever Hans, that "cagey" equine of yesteryear, left a legacy: not a scholarly tome, but the name of an "effect" which, when present in the investigative process, will contaminate the results—and, in turn one supposes, make the outcome a horse of a different color.

HOW WELL DID YOU READ?

How exact was your reading?

- 1. Clever Hans lived during the**
 - A late 19th century
 - B early 20th century
 - C middle 20th century
- 2. What was William von Osten's profession?**
 - A Psychologist
 - B Naturalist
 - C Educator
- 3. Clever Hans and Von Osten lived in**
 - A Germany
 - B Austria
 - C Hungary

- 4. To unconsciously clue a subject to the right answer is an example of the**
 - A halo effect
 - B Clever Hans effect
 - C Hawthorne effect

Can you draw the right conclusions?

- 5. The method used by Von Osten to teach Clever Hans can best be described as**
 - A humanistic psychology
 - B delayed gratification
 - C positive reinforcement
- 6. Which of these statements best summarizes the conclusion reached by the psychologists who studied Clever Hans?**
 - A Clever Hans is a unique horse and, in fact, does think.
 - B Although Von Osten and others don't realize it, they help the horse to get the right answer.
 - C William von Osten employs a helper to remain out of sight and give clues to Clever Hans.
- 7. Which of these best describes William von Osten?**
 - A Diligent and trustworthy
 - B Intelligent but dishonest
 - C Underhanded and greedy
- 8. If a subject is shown 12 each of 5 different pictures (a total of 60), how many should he or she be able, on the average, to guess right?**
 - A 5
 - B 12
 - C 25
- 9. The last sentence of the article ends with a**
 - A pun
 - B parody
 - C proverb

Did you understand the author's purpose?

- 10. The purpose of the article is primarily to**
 - A persuade
 - B amuse
 - C inform

LEARN ABOUT WORDS

A. Often you can tell the meaning of a word from its context—the words around it.

Directions: Find the word in the paragraph that means

1. outstanding (4)
2. printed in bright colors (5)
3. able to be seen; noticeable (6)
4. disagreeable; ill-natured (8)
5. naive girl or young woman (12)
6. prejudice; influence in a certain way (12)
7. takes advantage of (12)
8. more developed in one direction (12)
9. destructive; injurious (13)

B. A word may have more than one meaning. Its meaning depends on the way it is used.

Directions: Decide which meaning fits the word as it is used in the paragraph. Write the letter that stands before the meaning you choose.

10. title (1)
 - A name, as of a book, story, painting, etc.
 - B right to ownership, deed
 - C championship
11. commission (4)
 - A certificate conferring military rank
 - B charge, command to act
 - C group of persons directed to perform some duty
12. stage (5)
 - A step, one of a series of positions
 - B platform, place for performances
 - C station, place of rest
13. incline (7)
 - A bend forward
 - B tend toward an opinion
 - C deviate, or go off from, a line
14. pad (13)
 - A thin, flat mat
 - B tablet
 - C living quarters

C. The prefix *inter-* means “between” or “together.”

Directions: Decide the meaning of *inter-* in each word below. Write *between* or *together*.

- | | |
|----------------|-----------------|
| 15. interstate | 19. interweave |
| 16. interlace | 20. intercept |
| 17. interclass | 21. interval |
| 18. interfere | 22. interpreter |

D. An **idiom** is an accepted phrase or expression that does not mean literally what it says. “He took up with a bad crowd” does not mean that he helped a bad crowd lift something. It means that he became involved with a bad crowd.

Directions: The idioms in column II are built on the word *take*. Write the idiom that best fits each meaning in column I.

- | I | II |
|---|--------------------|
| 23. to be, act, or look like | take back |
| 24. become offended at | take for |
| 25. retract; regain possession of | take on |
| 26. dismantle; remove from a higher place | take it lying down |
| 27. regard as; consider as | take over |
| 28. cheat; trick; deceive | take off |
| 29. submit without protest | take after |
| 30. leave the ground | take one's time |
| 31. begin to do; undertake | take down |
| 32. be slow; delay | take in |
| 33. assume control | take amiss |