MORE ON THE NOT-THE-LIVER FALLACY: MEDICAL, NEUROPSYCHOLOGICAL, AND PERCEPTUAL DISSOCIATIONS

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«…You are in the audience of a well-attended medical conference, about to listen to the highly regarded Dr. Fright. 'I have a new discovery', Dr. Fright begins. 'I have isolated the organ system which removes toxins from the blood – I call it the 'liver''. Amidst oohs and ahs, Dr Fright provides some evidence for his discovery: 'when this organ is removed from a rat, toxins quickly build up, and the rat dies'. Applause from the crowd. 'But that is not all', the lecture continues, «I have discovered a second organ. This organ circulates the blood, absorbs nutrients, expels waste products from the body, and attacks foreign invaders.' 'For when the liver is removed', he argues, 'the body is still able to do all these things and more, until such time as the toxin buildup is fatal. I suggest we call this second organ 'Not-the-Liver'…'» (Bedford, 1997, p. 231).

This fictitious story illustrates an erroneous conclusion. There is no second «not the liver» organ. Rather, the evidence shows merely that the liver is not the only organ in the body. While in this context the conclusion is clearly absurd, I claim the same formal conclusion is drawn routinely about «mental organs» (cf. Gall, 1791; Chomsky, 1975) from dissociation data. The Not-the Liver fallacy (NTL) refers to *the erroneous conclusion that what remains after damage must be a coherent category, process, module, or natural kind.*

One example involves the universally known partition of memory into explicit and implicit components (Schacter, 1987, 1992). Implicit memory is founded on the NTL fallacy (Bedford, 1997). Damage to hippocampal structures produces a deficit in the ability to intentionally retrieve recently presented information while sparing the ability to do so indirectly or implicitly. A patient might fail to recall any words from a study list, or even that there was a study list, but then is more likely to use words from that list in various free association tasks. The NTL draws attention to the fact that while explicit memory is dissociated from «other stuff», the dissociation provides no way to understand that amorphous other stuff. The patient can also navigate the environment, perform mathematical calculations, show classical and operant conditioning, adapt to prism-displaced vision and so on and so on. There is no evidence that what remains following selective removal of one function is a coherent and meaningful category. Analogous to the way in which removal of the liver, or removal of an appendage, leaves merely person minus liver, or person minus arm, removal of explicit memory leaves only mind minus explicit memory.

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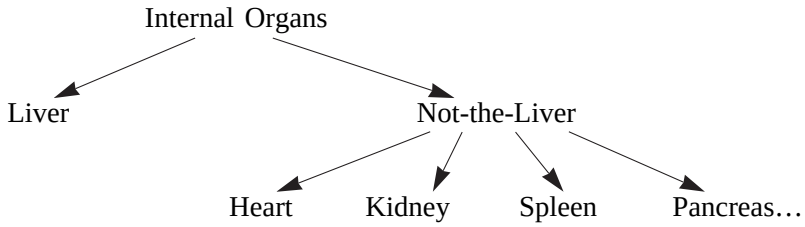
Note that the essence of the NTL is not that what remains is a big category that needs to be further subdivided to be of any use. Consider the following physical organ hierarchy.



As can be seen, Not-the-Liver can be further subdivided into organs, but that does not make it an organ. Similarly, according to NTL, there is no evidence that what remains functional following neurological damage, such as «not explicit memory», is meaningful, even if it can be subdivided. What remains following damage (e.g. implicit memory) is not a *heterogeneous* category; it is not a *category*. Nor does the double dissociation remove the NTL. Instead, it typically doubles the opportunity for the NTL.

Let «X» and «Y» be two mental functions that are said to doubly dissociate from one another. When X goes away with damage, what remains is usually a set of functions, not just Y (Y, Z, Q, W). The double dissociation picks one of those, Y, and removes it. What remains is usually more than X (X, H, J, L). «X» and «Y» are said to doubly dissociate but Y ≠ Not X and X ≠ Not Y. Double dissociations are rarely exact complements, and behave here instead as two single dissociations (See also Bedford, 1997). This presents two opportunities for the NTL, one for Not-X and one for Not-Y. According to the Not-the-Liver Fallacy, «Not-X» (Y, Z, Q, W) cannot be assumed to be a natural kind, nor can «Not-Y» (X, H, J, L). Apart from the NTL, whether Y and X can be extracted as meaningful from the «Not-X» set and «Not-Y» set respectively depends on whether for each single dissociation, when X is dissociated from «Not-X», X itself can be concluded to be a meaningful part. We turn to this issue.

If function «X» is removed, then according to the NTL, it cannot be concluded that what remains, «Not-X», is a meaningful part. Can anything be concluded about «X»? After all, «X» is no longer functional. A shift in the goal of neuropsychological dissociation data (see Dunn and Kirsner, this issue) may make that difficult as well. As noted by Dunn and Kirsner, dissociation data was first used to localize functions in the brain. The conclusions here are sound. If there is a selective deficit of «X» following removal of brain tissue, then there is evidence that the brain tissue is involved with the success of «X». For example, one *can* conclude that the memory dissociation shows that hippocampal structures are involved in the conscious intentional recollection of recently presented events, analogous to a conclusion that the liver is involved in toxin removal. However, if the goal shifts to partitioning the mind without regard to localization in the brain, then conclusions become problematic. A dissociation of «X» from other stuff does not provide compelling evidence that

«X» is a meaningful self-contained piece of the mind because it has not been show that «X» can function independently. In fact, the dissociation has done exactly the opposite – destroyed it.

To use neuropsychological dissociation data to form conclusions about modules of mind independent of brain localization requires that one test the assumption of the «dropped watch» model: that functions come apart at their seams when they are damaged. Behavioral psychological dissociation data are also informative. Suppose a subject points accurately at a small visible noisy object (e.g. Bedford, 1989). If the lights are turned off, thereby removing vision, she can still point accurately. Conversely, turn off the object's sound, and she again points accurately. In neuropsychology terms, there is a double dissociation between visual localization and auditory localization. A valid psychological conclusion, however, does not violate lessons of the NTL. Removal of visual access to the world shows that vision is not *necessary* for localization of an object in space. Likewise, audition is not necessary. These more conservative conclusions work for the medical example (the liver is not necessary for killing microorganisms), and the neuropsychological example (explicit memory is not necessary for acquiring new material) as well.

Psychological conclusions can go further and may appear to commit the fallacy. Consider the depth cue of binocular disparity in which the distances between corresponding points on each retina are measured to reconstruct depth. It is established by isolating – dissociating – the cue from others and demonstrating it can function independently. The invention of the random-dot stereogram (Julesz, 1971)[1] proved that depth can be still be perceived when only disparity between points remain. Thus, it appears as if what remains after dissociation («Not -X») is assumed to be a meaningful part, a depth cue, which would be the Not-the-Liver Fallacy. However, while there is a logical jump, the conclusion is shorthand for a longer series of conservative conclusions. Random-dot stereograms remove motion parallax by keeping the head still, which leads to «motion parallax is not required for depth perception». Stereograms remove convergence as a cue because all stimuli are at the same actual depth. Thus, «convergence is not required for depth perception». They remove meaning within each eye's view, which removes texture gradients, linear perspective, familiar size, etc.: «cues a-f are not required for depth perception». Behavioral isolation tends to keep chipping away by taking away more and more pieces to determine if what remains can still function as a coherent independent system. At some point there is a shift to a positive conclusion about what still remains, when it is «small enough». A rule of thumb may be *if more is taken away than what remains*, then what remains may be a meaningful part. It may be, however, that scrutiny renders this heuristic impractical. Much of the time, conservative conclusions are warranted. It is as if one takes small steps walking backward, gradually increasing the set of conclusions about what a meaningful piece is *not*, however frustrating that may be.

[1] In a random-dot stereogram, one image consists of random dots. A subset of those (e.g. a square) are displaced to form the second image, which is filled in with more random dots. Thus, each image by itself contains only random dots; a figure (e.g. square) exists only through comparison of the two images.

One final note is that what constitutes a meaningful piece may change depending on what the question is. Continuing with depth perception, «monocular depth cues» – cues that remain when the information from one eye is removed – may be guilty of the NTL. However, models of how different depth cues are integrated (Cutting and Vishton, 1996) do not actually use «monocular depth cues» as an intermediate processing step. There is no suggestion that monocular cues are integrated separately from the binocular ones with those two outputs subsequently integrated. The «category» serves instead as construct for convenience of the researcher. Depending on the goal, even person minus liver can be a meaningful part.

References

BEDFORD FL. Constraints on learning new mappings between perceptual dimensions. *Journal of Experimental Psychology: Human Perception and Performance, 15:* 232-248, 1989.

BEDFORD FL. False categories in cognition: The Not-the-Liver fallacy. *Cognition, 64:* 231-248, 1997.

CHOMSKY N. *Reflections on Language*. New York: Pantheon, 1975.

CUTTING JE and VISHTON PM. Perceiving layout and knowing distances: The interaction, relative potency, and contextual use of different information about depth. In W Epstein and S Rogers (Eds.), *Perception of space and motion*. San Diego CA: Academic Press, 1995, pp. 69-117.

DUNN JC and KIRSNER K. What can we infer from double dissociations? *Cortex*, in press.

GALL FJ. *Philosophisch-medicinische Untersuchungen*. Vienna: Graffer, 1791.

JULESZ B. *Foundations of Cyclopean Perception*. Chicago IL: University of Chicago Press, 1971.

SCHACTER DL. Associative memory: History and current status. *Journal of Experimental Psychology: Learning Memory and Cognition, 13:* 501-518, 1987.

SCHACTER DL. Understanding implicit memory: A cognitive neuroscience approach. *American Psychologist, 47:* 559-569, 1992.

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