Congenital prosopagnosia: diagnosis and mental imagery

Commentary on

Tree JJ and Wilkie J. Face and object imagery in congenital prosopagnosia:
A case series.

***Cortex*, in press.**

by Thomas Grüter[1], Martina Grüter[2] and Claus-Christian Carbon[1]

[1] University of Bamberg, Department of General Psychology and Methodology, Markusplatz 3, D-96047 Bamberg, Germany.

[2] Nottulner Landweg 33, D-48161 Münster, Germany

Running page heading: Congenital prosopagnosia: mental imagery

In a sample of four prosopagnosics Tree and Wilkie (in press) found an imagery deficit for faces, while the self-report questionnaires they used did not show any reduction in the vividness of visual mental imagery. They did not find any reduction of mental imagery for objects or colors in their subjects. The authors tested the imagery with a set of questions about external and internal facial features of celebrities and about features of objects. In our recent study (Grüter et al., 2009), explicitly referred to by Tree and Wilkie (in press), we evaluated the self-rated imagery of 53 congenital prosopagnosics and found that the vividness of their mental imagery was quite low – in fact the prosopagnosic group showed the lowest average mental imagery scores ever published for a non-brain-damaged group. This reduction of imagery capabilities was more pronounced for faces than for objects.

The difference between Tree's and Wilkie's results and ours may have several reasons: First, they examined a smaller sample than we did (4 prosopagnosics against 53 in our study). Second, the different diagnostic procedures may play a role. Third, the different interpretation of visual mental imagery assessment methodology has to be considered. A fourth reason may be their selection of controls.

Our diagnostic criteria for congenital prosopagnosia differ from theirs. First of all, prosopagnosia is a symptom, not a condition or a disease per se. Like in the case of headaches, the complaints need to be specified before any useful additional studies can be done. Tree and Wilkie (in press) label all cases unequivocally as “congenital prosopagnosics” by referring to Jones’ and Tranel’s (2001) criteria, although Jones and Tranel investigated a 5 year-old boy with developmental prosopagnosia—a type of prosopagnosia that is not necessarily congenital.
Our studies have indicated that people with congenital prosopagnosia (cPA) typically show a distinct pattern of complaints (Table 1). The leading symptom in cPA is an irritating inability to decide whether a face is familiar or not (Grüter et al., 2009; Grueter et al., 2007; Grüter et al., 2008). This discerns the condition from acquired prosopagnosia, where most affected people report that all face look definitely unfamiliar to them.

[insert Table 1 about here]

Aiming at an enhancement of the specification of complaints we also ask for face-related cognitive function impairments not normally associated with cPA. These include the recognition of facial emotions (Humphreys et al., 2007), recognition of facial attractiveness (Carbon et al., 2010), recognition of gender from faces (Grüter et al., 2008), color vision (often impaired in acquired prosopagnosia), field of vision (often reduced in acquired prosopagnosia) (Bouvier and Engel, 2006), semantic memory for persons, and person recognition from non-facial clues (Grüter et al., 2008). If the interviewee reports problems with these cognitive functions, he/she may suffer from a different condition, in which PA is just one symptom (see Grüter et al., 2008, for a more detailed discussion on the differential diagnosis).

Our behavioral diagnostic procedure uses a semi-structured interview form conducted by an experienced physician or psychologist. The interviewee does not fill out any form, all forms (see supplementary online material) must be filled out by the interviewer. The interview should also cover the complete medical and neurological history in order to exclude any condition that may mimic a prosopagnosia like for example social phobia, brain tissue damage in infancy, psychiatric conditions, autism spectrum disorders, etc. Our experience shows that the interview tends to take at least one hour, in many cases two hours or longer. We have verified the behavioral diagnostic method with face recognition test batteries in 21 people with cPA. The behavioral diagnosis was confirmed in each single case (Grüter et al., 2008). Assessing the complete behavioral pattern of cPA has become more important in the last few years. In the last two years, we have received an increasing number of inquiries to provide medical expertise for handicap ratings of cPA cases. Potentially affected people have a strong financial interest in the outcome. Ruling out manipulations is thus an important issue in this setting. This is difficult to achieve with most face tests, because they are quite transparent to the participants. Above that, test-retest reliabilities of face recognition tests have not been assessed so far. For famous-face tests, even the inter-rater reliability is poor, because “famous” is an ill-defined attribute (Carbon,

2008). Therefore, even from a strictly formal standpoint, face tests have a limited validity. Only the “face validity” (the *prima facie* or *apparent* validity) is high, rendering the tests vulnerable to manipulation. While Tree and Wilkie (in press) verify the face recognition deficit as a symptom, they do not assess the *pattern* of complaints. This is like verifying a headache in a patient, but not assessing the pattern that would, for example, identify it as a migraine type of headache. A heterogeneous group of prosopagnosics may, of course, yield heterogeneous results (Le Grand et al., 2006).

As mentioned above, a second reason why our results for the vividness of visual mental imagery differ from Tree’s and Wilkie’s may be the different ideas about mental imagery. In their paper, they criticize our usage of subjective measures. Vividness of mental imagery is by its very definition a subjective measure and is, of course, error-prone. Still, a metastudy concluded that the mean reliability of the VVIQ is quite high, with internal consistency being high (Cronbach’s alpha = .885) and test-retest reliability being medium up to high with $R = .764$ (McKelvie, 1995; Table 1). It should also be noted that an fMRI study has shown that the vividness of mental imagery correlates with the activity of certain occipital brain areas (Cui et al., 2007).

Tree and Wilkie prefer to assess the accuracy (as compared to vividness) of mental imagery because they regard the accuracy as a more objective measure. We hold a different opinion, though. In our paper (Grüter et al., 2009) we have pointed out that vividness and accuracy are two orthogonal dimensions of mental imagery. We wrote (p. 136): “Most of these previous studies attempted to test the *accuracy* of visual mental imagery using task-based questions like ‘does a tractor have big wheels on the front or on the back’ or ‘who had the bigger moustache: Hitler or Stalin?’. Participants may, of course, exploit their semantic memory to help with the answers, thus limiting the specificity of the test. They may just know that Hitler’s moustache was a narrow one while Stalin’s would cover the whole space between nose and upper lip. The VVMI [Vividness of Visual Mental Imagery], though, is an important additional dimension of mental imagery. You may vividly – but wrongly – imagine a tractor with two big front wheels (e.g. Lampinen et al., 2005).”

It is questionable whether the vividness of mental imagery can be dubbed as subjective and the correctness be characterized as an independent experimental measure. As a result, the questions that are devised to test “objective” mental imagery may well turn out to test world knowledge instead. As we pointed out in a recent paper: “With one or more dysfunctional cognitive skills, cognition may still reach a sufficient functional level, but the cognitive network will become stretched and bent in the process. Therefore, any congenital functional or anatomical differences [...] will cause the neural networks to develop and connect in specifically different ways and lead to typical behavioral changes.” (Grüter and Carbon, 2010, p.436).

If someone never relied on mental imagery for objects he/she will find other ways of internal object representation. As a sample question Tree and Wilkie (in press) quoted: “What looks more like a horse-chestnut tree? Oak or birch?” People who could never rely on mental imagery could still easily answer the question by just evaluating the usual adjectives commonly attributed to these trees (horse chestnut and oak: dark bark, huge; birch: white bark, small). Therefore we would be careful to infer an undisturbed mental imagery from correct answers to questions like the one above. Tree and Wilkie (in press) state that they have used our modified Vividness of Visual Imagery Questionnaire (VVIQ). We have included our Questionnaire as online supportive material. Judging from their description, there seem to be some differences, though, that may or may not account for some of the differences in the results.

In part, Tree’s and Wilkie’s results may differ from ours, because their controls have the lowest average score for visual mental imagery ever found in a normal sample (for a metastudy see McKelvie, 1995). The score of their controls is similar to our findings for prosopagnosics (Grüter et al., 2009). Please note: In our and most other VVIQ studies, a score of “1” denotes the best vividness, a score of “5” the poorest. Tree and Wilkie use a reverse numbering, they have used “5” for the best vividness, “1” for the poorest. This should be taken into account when comparing the figures. The low controls’ scores for the vividness of mental imagery may be connected to the low controls’ average score in the Bentin Face

Recognition Test (short form). Tree and Wilkie report an average score of 21 (no variance) which is the lower boundary for a normal score (Levin et al., 1975). We may therefore infer that a large number of their controls must have scored below the normal range.

In conclusion, the differences between their results and ours can be explained by the somewhat unusual scores of their controls as well as by the low number of participants in their target group. Conducting another diligent large scale study about the vividness of mental imagery in congenital prosopagnosics may be useful to clarify the matter.

Author Note

This study was supported by a research grant (FNK) of the University of Bamberg to CCC. We thank two anonymous reviewers and Sergio Della Sala for their comments and helpful remarks.

References

Behrmann M, Avidan G, Gao F, and Black S. Structural imaging reveals anatomical alterations in inferotemporal cortex in congenital prosopagnosia. *Cerebral Cortex*, 17 (10):2354-2363, 2007.

Bouvier SE and Engel SA. Behavioral deficits and cortical damage loci in cerebral achromatopsia. *Cerebral Cortex*, 16 (2):183-191, 2006.

Carbon CC. Famous faces as icons. About the illusion of being an expert in the recognition of famous faces. *Perception*, 37 (5):801-806, 2008.

Carbon CC, Grüter T, Grüter M, Weber JE, and Lueschow A. Dissociation of facial attractiveness and distinctiveness processing in congenital prosopagnosia. *Visual Cognition*, 18 (5):641-654, 2010.

Cui X, Jeter CB, Yang DN, Montague PR, and Eagleman DM. Vividness of mental imagery: Individual variability can be measured objectively. *Vision Research*, 47 (4):474-478, 2007.

Grueter M, Grueter T, Bell V, Horst J, Laskowski W, Sperling K, Halligan PW, Ellis HD, and Kennerknecht I. Hereditary prosopagnosia: The first case series. *Cortex*, 43 (6):734-749, 2007.

Grüter T and Carbon CC. Escaping attention. Some cognitive disorders can be overlooked. *Science*, 328 (5977):435-436, 2010.

Grüter T, Grüter M, Bell V, and Carbon CC. Visual mental imagery in congenital prosopagnosia. *Neuroscience Letters*, 453 (3):135-140, 2009.

Grüter T, Grüter M, and Carbon CC. Neural and genetic foundations of face recognition and prosopagnosia. *Journal of Neuropsychology*, 2 (Pt 1):79-97, 2008.

Humphreys K, Avidan G, and Behrmann M. A detailed investigation of facial expression processing in congenital prosopagnosia as compared to acquired prosopagnosia. *Experimental Brain Research*, 176 (2):356-373, 2007.

Jones RD and Tranel D. Severe developmental prosopagnosia in a child with superior intellect. *Journal of Clinical and Experimental Neuropsychology*, 23 (3):265-273, 2001.

Lampinen JM, Meier CR, Arnal JD, and Leding JK. Compelling untruths: Content borrowing and vivid false memories. *Journal of Experimental Psychology. Learning Memory and Cognition*, 31 (5):954-963, 2005.

Le Grand R, Cooper PA, Mondloch CJ, Lewis TL, Sagiv N, De Gelder B, and Maurer D. What aspects of face processing are impaired in developmental prosopagnosia? *Brain and Cognition*, 61 (2):139-158, 2006.

Levin HS, Hamsher KDS, and Benton AL. Short form of test of facial recognition for clinical use. *Journal of Psychology*, 91:223-228, 1975.

McKelvie SJ. The vviq and beyond: Vividness and its measurement. J*ournal of Mental Imagery*, 19 (3-4):197-252, 1995.

Tree JJ and Wilkie J. Face and object imagery in congenital prosopagnosia: A case series. *Cortex*, in press.

Table 1: Symptoms of cPA. Typically, all these symptoms are reported (Grüter et al., 2008)**.**

Symptom	**Description**
Lasting and irritating subjective uncertainty of face recognition.	People with cPA don't just judge other people as unknown. Instead, they suffer from a vexing inability to decide, whether they know a face or not.
False negative and false positive face recognition events.	People with cPA tend to overlook familiar people and to confuse strangers with familiar people.
Face recognition time longer than socially accepted.	People with cPA tend to stare for an unduly long time at people to decide if they know them.
No gaze contact in social interaction.	People with cPA also report that they feel no need for gaze contact to other people when they talk to them. Most of them also say that they have learned that other people will find this irritating.
Automated adaptive behavior.	People with cPA show an adaptive behavior in order to avoid or alleviate embarrassing situations. They also use other means of recognition (gait, hairstyle, voice etc.).
cPA most often surfaces in out-of-context encounters.	The face recognition problems are worst when environmental and circumstantial clues are scarce, for example in crowded places like supermarkets or airports.
Use of explicit person learning and recognition strategies.	Most people with cPA have developed explicit learning strategies for visual person recognition. *Explicit* means that they can tell you, what kind of features they memorize in order to recognize people.
Other visual recognition deficits.	Most people with cPA also report deficits in the visual recognition of objects and scenes. This indicates that the face recognition deficit may be only the tip of an yet

unidentified iceberg.