British Journal of Psychology (2011), 102, 615–622


The British Psychological Society

www.wileyonlinelibrary.com

# Creativity and ease of ambiguous figural reversal

Richard Wiseman[1], Caroline Watt[2]*, Kenneth Gilhooly[1] and George Georgiou[1]

[1]School of Psychology, University of Hertfordshire, Hatfield, Herts, UK
[2]Department of Psychology, University of Edinburgh, Edinburgh, UK

Two studies examined the relationships between self-rated and objectively measured creative ability and ease of perceiving alternative interpretations of the ambiguous Duck–Rabbit figure. The studies found empirical support for what has previously been a largely analogical connection between figural reversal and creativity, using both self-rated trait creativity and objectively scored creative productivity. We discuss the hypothesis that executive functioning is the likely common cognitive factor linking perception of ambiguous figures and creative ability.

Creative thinking results in novel and useful combinations of already-known mental elements (Batey & Furnham, 2006), such as representations of concepts, objects, and actions. Perceptual restructuring (i.e., seeing patterns in new ways) and conceptual restructuring (understanding situations in different ways) are two principal ways that novel ideas may arise. How useful novel combinations are generated through perceptual and conceptual restructuring is the key question for understanding creativity. It has often been noted that creative ideas seem to occur suddenly, after a period of impasse (Metcalfe & Weibe, 1987; Ohlsson, 1992) and that the phenomenology of having a creative idea is similar to that of suddenly seeing an ambiguous figure in a new way (Schooler & Melcher, 1995).

Thus, clues to understanding conceptual restructuring may come from the similarity between the sudden realization of a creative idea in consciousness and the sudden perceptual restructuring that occurs when people study ambiguous figures (Schooler & Melcher, 1995). The well-known Necker cube and the Duck–Rabbit figure (Jastrow, 1899) are examples of ambiguous reversible figures that typically generate alternative and indeed alternating structures. In the Necker cube, perception alternates between a cube with the leading face to the right or left and in the Duck–Rabbit, perception alternates between a duck facing one way and a rabbit facing the other (see Figures 1 and 2 below).

Turning to possible links between perceptual and conceptual restructuring and creativity, Gestalt problem solving theorists, such as Duncker (1945) and Köhler (1948),

*Correspondence should be addressed to Department of Psychology, University of Edinburgh, 7 George Square, Edinburgh EH8 9JZ, UK (e-mail: Caroline.Watt@ed.ac.uk).

DOI:10.1111/j.2044-8295.2011.02031.x

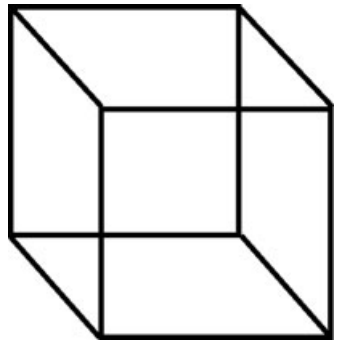

**Figure 1.** Necker cube.

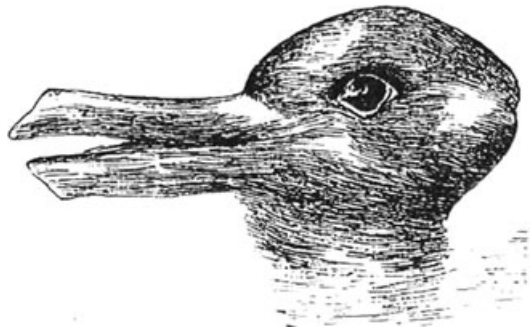

**Figure 2.** The Jastrow Duck–Rabbit image.

drew explicit analogies between creative problem solving and figural reversals in perception. As Ellen (1982, p. 324) noted, the appearance of creative solutions:

> was akin to what occurs in the process of experiencing a figure-ground reversal (Maier, 1930). The perception is sudden, the subject is unaware of an intermediate stage, and there is a change in the meaning of the elements of the problem. Elements at one moment are seen as one unity: at the next moment, another unity appears with the same elements. In short, the Gestalt view of problem solving places it in the category of a perceptual experience rather than in the general framework of learning and memory phenomena.

The question arises as to whether there is a *general* ability to re-structure mental representations that underlies both perceptual and conceptual restructuring. If this is so, we would expect to find correlations between measures of perceptual restructuring and of conceptual restructuring.

Some support for the view that perceptual and conceptual restructuring are linked was reported by Schooler and Melcher (1995) who found a significant correlation between creative insight problem solving (conceptual restructuring) and a measure of perceptual restructuring based on the ease with which participants recognized an out-of-focus picture (Bruner & Potter, 1964). The out-of-focus picture tasks produce sudden shifts in perceptual organization from having no idea what the object is to complete certainty.

In the area of creativity, some studies have reported relationships between self-rated trait creativity and rates of ambiguous figure reversal (Bergum & Bergum, 1979a,b).

However, these findings were not replicated by Simpson, Lansky, Senter, and Peterson (1983) in a study examining figure reversal rates and both self-rated and instructor-rated trait creativity. Bergum and Flamm (1975) found a non-significant positive trend between figure reversal rates and trait creativity scores, derived from biographical and adjective checklist forms. The null results arose from studies with small *N*s and so may be due to low statistical power. Riquelme (2002) found a significant relationship between performance on a visuo-spatial creative synthesis task (Finke & Slayton, 1988) and ease of detecting ambiguous figure reversals.

The present paper reports studies that focus on the possible link between perceptual restructuring and creativity. The studies reported here have substantial *N*s to ensure reasonable power. Study 1 employed self-rated trait creativity, as did previous studies in the area. Study 2 used objective measures of creative production from Alternative Uses Tasks (Guilford, Christensen, Merrifield, & Wilson, 1978) and so examined links between perceptual restructuring and measurable creative performance.

## STUDY 1

### Method

#### *Participants*

A volunteer panel was emailed an invitation to take part in an online study. The panel consisted of members of the public who had previously expressed an interest in participating in studies conducted by the first author. Five hundred and ninety-three individuals participated (57% males, 43% females); they were not compensated for taking part. The ages and nationality of participants were not recorded.

#### *Procedure*

Participants were shown the Duck–Rabbit image. They were informed that it was an ambiguous figure, and that it could be viewed as a duck or a rabbit. They were asked to indicate which animal they first saw (response options – 'duck', 'rabbit'); how easy they found it to see the opposite animal to the one they first saw ('very easily', 'easily', 'not at all easily', 'cannot see the other animal'); and whether they would describe themselves as artistically creative, and as a creative problem solver ('definitely yes', 'yes', 'uncertain', 'no', 'definitely no'). Participants were also asked to indicate whether they had seen the 'Duck–Rabbit' image before ('yes', 'no').

### Results and Discussion

Just over half of the participants (54.6%) reported that they had seen the Duck–Rabbit image before the study. The majority (85.83%) of participants reported seeing the duck first. There was no relationship between which animal was first seen and self-rated artistic creativity or self-rated creative problem solving (artistically creative: Spearman's *rho* [corrected for ties] = 0.05, $Z = 1.20$, $p$ [two tailed] = .23; creative problem solver: Spearman's *rho* [corrected for ties] = 0.05, $Z = 1.15$, $p$ [two tailed] = .25). There was also no relationship between whether they had seen the 'Duck–Rabbit' image before the study and self-rated artistic creativity or self-rated creative problem solving (artistically creative: Spearman's *rho* [corrected for ties] = 0.01, $Z = 0.30$, $p$ [two tailed] = .76; creative problem solver: Spearman's *rho* [corrected for ties] = −0.03, $Z = -0.76$, $p$ [two tailed] = .45).

**Table 1.** Percentage and numbers (in parentheses) of participants who reported that they could 'very easily' and 'easily' see the opposite animal

| | Definitely yes | Yes | Uncertain | No | Definitely no |
|---|---|---|---|---|---|
| Artistically creative | | | | | |
| Very easily | 23.60 | 34.79 | 16.06 | 22.38 | 3.16 |
| | (97) | (143) | (66) | (92) | (13) |
| Easily | 13.19 | 27.78 | 22.92 | 30.56 | 5.56 |
| | (19) | (40) | (33) | (44) | (8) |
| Not at all easily | 19.35 | 16.13 | 16.13 | 29.05 | 19.35 |
| | (6) | (5) | (5) | (9) | (6) |
| I cannot see it | 0 | 42.86 | 28.57 | 28.57 | 0 |
| | (0) | (3) | (2) | (2) | (0) |
| Creative problem solver | | | | | |
| Very easily | 32.12 | 51.34 | 14.11 | 2.43 | 0 |
| | (132) | (211) | (58) | (10) | (0) |
| Easily | 22.22 | 54.86 | 16.67 | 6.25 | 0 |
| | (32) | (79) | (24) | (9) | (0) |
| Not at all easily | 9.68 | 54.84 | 25.81 | 3.23 | 6.45 |
| | (3) | (17) | (8) | (1) | (2) |
| I cannot see it | 0 | 57.14 | 42.86 | 0 | 0 |
| | (0) | (4) | (3) | (0) | (0) |

There were, however, strong relationships between self-rated creativity and the ease of perceiving the two animals in the image (see Table 1: artistically creative: Spearman's *rho* [corrected for ties] = 0.17; $Z = 4.26$, $p$ [two tailed] < .0001; creative problem solver: Spearman's *rho* [corrected for ties] = 0.17, $Z = 4.04$, $p$ [two tailed] < .0001). As predicted, those who described themselves as more creative reported finding it easier to flip between the two interpretations of the image.

The results of this study are consistent with previous results relating self-judged trait creativity to figural reversal (Bergum & Bergum, 1979a,b) and it may be suggested that previous failures to replicate these findings (Bergum & Flamm, 1975; Simpson *et al.*, 1983) were due to lack of power in those studies as compared to the present Study 1.

However, Study 1 relied on self-report measures of creativity. This does not enable us to rule out the possibility that the significant relationships that emerged were due to participants' response biases, such as giving a socially desirable response, and may not reflect a real link between creative performance and figural reversal. Study 2 therefore used performance on a standard creative problem-solving task as the dependent variable to be predicted by ease of figural reversal.

## STUDY 2

### Method

#### *Participants*

Participants were 93 prospective undergraduate psychology students and their parents attending a talk during a University Open Day (27% males, 73% females); they were not compensated for taking part. The ages and nationality of participants were not recorded.

### *Procedure*

Participants were shown the Duck–Rabbit image for approximately 30 s.

They were informed that it was an ambiguous figure, and that it could be viewed as a duck or a rabbit. They were then given a few minutes to complete the questionnaire, indicating: which animal they first saw (response options – 'duck', 'rabbit'); and how easy they found it to see the opposite animal to the one they first saw ('very easily', 'easily', 'not at all easily', 'cannot see the other animal'). They were then asked to complete one of two shortened versions of Guilford's Alternative Uses Task (Guilford *et al.*, 1978) where they were asked to list as many possible uses for either a brick or a paperclip. Participants were given the following instructions: 'In a moment, I would like you to list as many different uses as you can think of for a common object. For example, the normal use for a newspaper is for reading, but it can also be used for swatting flies, to line drawers, to make a paper hat, and so on. You will be told how the object is normally used but you are to try and produce as many possible uses that are different from the object's normal use and uses that are different to each other. Please write down as many uses as you can until asked to stop'.

The two versions of the questionnaire were distributed amongst the audience so that adjacent participants' responses would be independent.

## Results and Discussion

### *Task scoring*

To avoid possible scoring bias, the alternate uses listed during the creative problem-solving task were scored blind to participants' responses to the question about ease of seeing the opposite animal. As the instructions were for participants to strive to list as many different and novel uses for the objects as they could, responses that were not different from the normal use for the objects received no points. The decision on what was a novel use was based on the function for which the object was originally designed. For example, the brick was designed for construction so the response 'building a wall' for the brick was not novel. Each novel and different response (e.g., 'a footrest', 'a device to save water in toilet cisterns' for the brick) was given a point. Multiple novel but similar responses were combined and given just a single point. A response was judged as similar if it fell into the same functional category. For example, 'a ring' and 'an earring' for the paperclip both fall into the category jewellery, so would be assigned only one point. Therefore, no single listed item could receive more than one point. These points were summed to provide a single score for each participant. The resulting score is essentially an indicator of flexibility '... with respect to the variety of perspectives represented in the ideas' (Plucker & Renziller, 1999, p. 39). Two raters scored the questionnaires independently. Inter-rater reliability was very high (Pearson's $r = .93$), so the results were based on the scoring of the first rater.

Just over one quarter (26.6%) of participants indicated that they had seen the Duck–Rabbit image before the study. Ninety-four per cent of participants reported seeing the duck first. There was no relationship between which animal was first seen and scores on the creativity test: Spearman's *rho* (corrected for ties) $= -0.01$, $Z = -0.14$, $p$ (two tailed) $= .89$.

Table 2 shows the average number of unusual alternate uses produced by participants, categorized into groups according to the ease with which they reported they could see the opposite animal in the ambiguous figure. There was again a clear relationship, with those participants who said they found it difficult to see the opposite animal coming

**Table 2.** Average number of alternate uses (standard deviations in parentheses) produced by participants according to the ease of seeing opposite animal

| | Very easily $N = 46$ | Easily $N = 34$ | Not at all easily $N = 7$ | I cannot see it $N = 7$ |
|---|---|---|---|---|
| Average number of alternate uses | 4.78 (2.38) | 3.62 (1.83) | 3.57 (2.57) | 1.80 (.96) |

up with significantly fewer alternate uses than those who could easily see the opposite animal (Spearman's *rho* [corrected for ties] = 0.28, $Z = 2.70$, $p$ [two tailed] = .007). *Post hoc* testing showed that those in the 'very easy' group produced significantly more uses than those in both the 'easy' (Fisher protected least significant difference (PLSD) = .96) and 'I cannot see it' (Fisher PLSD = .2.25) groups. None of the comparisons between the other groups reached significance.

The results of Study 2 strongly indicate that production of unusual uses for familiar objects is linked to ease of figural reversal. The results are consistent with Riquelme's (2002) observation that production of unusual figures from component shapes was related to figural reversal ability.

## GENERAL DISCUSSION

The present studies found empirical support for what has previously been a largely analogical connection between figural reversal and creativity, using both self-rated trait creativity and objectively scored creative productivity. What could be the basis of this relationship?

Gestalt approaches to creative problem solving stressed the role of spontaneous restructuring of the solver's understanding and perception of the problem materials. In the Gestalt view, both restructuring in creative tasks and in figural reversal is automatic, and cannot be controlled by the solver. This contrasts with the more recent information processing view that restructuring in insight tasks requires conscious application of heuristics to explore alternative ways of conceptualizing the materials (Fleck & Weisberg, 2004; Gilhooly & Fioratou, 2009; Gilhooly & Murphy, 2005; Kaplan & Simon, 1990).

Recent research on perception of ambiguous figures suggests that, counter to the Gestalt approach, executive functions are involved in perceiving alternative interpretations of ambiguous figures. Developmental studies have found that young children do not generally perceive alternatives in the Duck–Rabbit image until 5 years of age (Rock, Gopnik, & Hall, 1994). Doherty and Wimmer (2005) and Bialystok and Shapero (2005) relate the development of ambiguity perception in the Duck–Rabbit type of figure to the development of executive functions that can inhibit initial interpretations and engage attentional control to scan the figure and to prompt different interpretations. Doherty and Wimmer (2005) also implicate the development of imagery ability as a factor.

The role of executive processes in creative divergent thinking has been supported by Gilhooly, Fioratou, Anthony, and Wynn (2007) in a think aloud protocol analysis study that implicated effortful strategies such as imagining the object being disassembled or scanning images of the object to detect attributes that would then evoke or cue uses. A second study (Gilhooly *et al.*, 2007) found direct correlations between efficiency measures of the executive function of switching and the novelty of alternative uses generated. In the case of creative insight tasks, Fleck and Weisberg (2004) again

found evidence from think-aloud data of conscious executively controlled strategies. Gilhooly and Murphy (2005) in a correlational study found that creative insight problem solving was significantly linked to measures of the executive functions of inhibition and switching.

The studies reported in this paper do have some limitations. Although our findings are consistent with an executive control account of creativity and figural reversal, the present studies are unable to rule out the alternative interpretation that either general intelligence or spatial ability is the common factor underlying both creativity and figural reversal. It thus remains for future research to address this issue. Also, the present studies may have introduced a bias by not counterbalancing the order of presentation of the response options to the question of which animal is seen first. Further, the method of data collection in the present studies (group testing in Study 1, online testing in Study 2) made it more expedient to use self-report measures of ease of figural reversal. This is particularly a weakness for Study 1, which correlated self-reported ease of figural reversal with self-rated creativity. Additionally, as single item measures of creativity were used in Study 1, the reliability of these measures cannot be assessed. Objective measures of figural reversal, such as time to first reversal, would be preferable for future studies.

Overall, it seems plausible that the common factor underlying figural reversal and creativity is executive control, which has been shown to be important in both task areas. Although this conclusion is counter to the classical Gestalt account, which stresses spontaneous, uncontrolled processes as underlying both conceptual insight and perceptual restructuring, we may note that even the executive function account still includes a degree of automatic processing. For example, in the Alternative Uses Task the participant may executively decide to scan the brick image and its roughness may be noted and evoke a use of scraping a surface of chewing gum; however, which features are noticed first and what uses are evoked by those features seem to be based on automatic processes. A similar mix of top-down (executive) and bottom-up processes seems to be involved in Duck–Rabbit reversal. If attention is focussed on one side a rabbit interpretation is automatically retrieved and if the attentional focus moves to the other side a duck interpretation is automatically generated. The role of executive processes may be clarified in future research through inclusion of measures of executive functioning.

Finally, we may note that three types of ambiguous figures have been identified (Long & Toppino, 1981) viz., figure-ground reversals (such as vases–faces), perspective reversals (such as Necker cube) and meaning-content reversals (such as the Duck–Rabbit). Our present studies used only one meaning-content reversal figure and it would be interesting for future work to repeat Studies 1 and 2 with figure-ground and perspective reversals that may involve different mixtures of top-down and bottom-up processing and so have different linkages to creative thinking.

## References

Batey, M., & Furnham, A. (2006). Creativity, intelligence and personality: A critical review of the scattered literature. *Genetic, Social and General Psychology Monographs*, *132*(4), 355–429. doi:10.3200/MONO.132.4.355-430

Bergum, B. O., & Bergum, J. E. (1979a). Creativity, perceptual stability, and self perception. *Bulletin of the Psychonomic Society*, *14*, 61–63.

Bergum, B. O., & Bergum, J. E. (1979b). Self-perceived creativity and ambiguous figure reversal rates. *Bulletin of the Psychonomic Society*, *14*, 373–374.

Bergum, B. O., & Flamm, L. E. (1975). Perceptual stability, image size, binocularity and creativity. *Perceptual and Motor Skills*, *41*, 667–671.

Bialystok, E., & Shapero, D. (2005). Ambiguous benefits: The effect of bilingualism on reversing ambiguous figures. *Developmental Science*, *8*, 595–604. doi:10.1111/j.1467-7687.2005.00451.x

Bruner, J., & Potter, M. (1964). Interference in visual recognition. *Science*, *144*, 424–425. doi:10.1126/science.144.3617.424

Doherty, M. J., & Wimmer, M. C. (2005). Children's understanding of ambiguous figures: Which cognitive developments are necessary to experience reversal? *Cognitive Development*, *20*, 407–421. doi:10.1016/j.cogdev.2005.05.003

Duncker, K. (1945). On problem solving. *Psychological Monographs*, *58*(5) (Whole No. 270).

Ellen, P. (1982). Direction, past experience and hints in creative problem solving: Reply to Weisberg and Alba. *Journal of Experimental Psychology: General*, *111*, 316–325. doi:10.1037//0096-3445.111.3.316

Finke, R. A., & Slayton, K. (1988). Explorations of creative visual synthesis in mental imagery. *Memory & Cognition*, *16*, 252–257. doi:10.3758/BF03197758

Fleck, J. L., & Weisberg, R. W. (2004). The use of verbal protocols as data: An analysis of insight in the candle problem. *Memory & Cognition*, *32*, 990–1006. doi:10.3758/BF03196876

Gilhooly, K. J., & Fioratou, E. (2009). Executive functions in insight v. non-insight problem solving: An individual differences approach. *Thinking & Reasoning*, *15*, 355–376. doi:10.1080/13546780903178615

Gilhooly, K. J., Fioratou, E., Anthony, S. H., & Wynn, V. (2007). Divergent thinking: Strategies for generating alternative uses for familiar objects. *British Journal of Psychology*, *98*, 611–625. doi:10.1111/j.2044-8295.2007.tb00467.x

Gilhooly, K. J., & Murphy, P. (2005). Differentiating insight from non-insight problems. *Thinking and Reasoning*, *11*, 279–302.

Guilford, J. P., Christensen, P. R., Merrifield, P. R., & Wilson, R. C. (1978). *Alternate Uses: Manual of instructions and interpretations*. Orange, CA: Sheridan Psychological Services.

Jastrow, J. (1899). The mind's eye. *Popular Science Monthly*, *54*, 299–312. doi:10.1037/10919-008

Kaplan, C. A., & Simon, H. A. (1990). In search of insight. *Cognitive Psychology*, *22*, 374–419. doi:10.1016/0010-0285(90)90008-R

Köhler, W. (1948). *The mentality of apes*. London: Kegan Paul.

Long, G. M., & Toppino, T. C. (1981). Multiple representations of the same reversible figure: Implications for cognitive decisional interpretations. *Perception*, *10*, 231–234. doi:10.1068/p100231

Maier, N. R. F. (1930). Reasoning in humans. I. On direction. *Journal of Comparative Psychology*, *10*, 115–143.

Metcalfe, J., & Weibe, D. (1987). Intuition in insight and noninsight problem solving. *Memory and Cognition*, *15*, 238–246. doi:10.3758/BF03197722

Ohlsson, S. (1992). Information processing explanations of insight and related phenomena. In K. J. Gilhooly, & M. Keane (Eds.), *Advances in the psychology of thinking*. London: Harvester Wheatsheaf.

Plucker, J. A., & Renziller, J. S. (1999). Psychometric approaches to the study of human creativity. In R. J. Sternberg (Ed.), *Handbook of creativity*. Cambridge, MA: Cambridge University Press.

Riquelme, H. (2002). Can people creative in imagery interpret ambiguous figures faster than people less creative in imagery? *Journal of Creative Behavior*, *36*, 105–116.

Rock, I., Gopnik, A., & Hall, S. (1994). Do young children reverse ambiguous figures? *Perception*, *23*, 635–644.

Schooler, J. W., & Melcher, J. (1995). The ineffability of insight. In S. Smith, T. Ward, & R. Finke (Eds.), *The creative cognition approach*. Cambridge, MA: MIT Press.

Simpson, M. T., Lansky, L. M., Senter, R. J., & Peterson, J. M. (1983). Figure reversals and creativity: A research note. *Perceptual and Motor Skills*, *57*, 582.

*Received 16 November 2010; revised version received 14 February 2011*