effect of order or pack, and other measures of difficulty lead to similar concordances. Experiment 1 thus showed that disjunctive problems are harder than conjunctive ones (confirming a result of Bruner *et al.*), and that polymorphous problems are harder than either.

In experiment 1, subjects could only acquire information gradually. In experiment 2, all possible information was available from the start. Six more undergraduates served. Cards were selected from the packs used in experiment 1 to make packs of eight including every combination of the three stimulus dimensions. These were laid out on a table, segregated into groups labelled A and B. The experimenter told the subject that a simple rule determined whether a card belonged to group A, asked him to find it as quickly as possible, and measured the time until he offered an acceptable rule. Unacceptable rules were refuted by pointing to counter-examples. The maximum time allowed was 10 min. Each subject faced one problem of each type (conjunctive, disjunctive and two-out-of-three polymorphous); order and pack were again counter-balanced, and the subjects were told before they started each problem what three dimensions might be relevant to it. Their task was thus like the puzzle we set the reader at the beginning of this communication.

Once again, every subject did worst on the polymorphous problem. The median times to solution (scoring 10 min for complete failure) were 34 s, 2 min 35 s and 10 min for conjunctive, disjunctive and polymorphous problems respectively; four subjects failed to solve the polymorphous problem (the other two gave the rule as a disjunction of conjunctions). Kendall concordance between subjects as to order of difficulty was 0.63, significant at the 0.05 level[4]. There was no effect of pack or order of presentation. The two experiments lead to the same conclusion—that polymorphous rules are very hard to discover. The total failures to solve the polymorphous problems prevent us setting figures on their difficulty, but the direction of the result is unambiguous.

Linguistic philosophy gives peculiar importance to the polymorphous rule. Ryle[1,5] suggests that many philosophically important concepts (such as "thinking") and everyday terms (such as "solicitor") have polymorphous definitions, whereas Wittgenstein[6] seems to suggest that such definitions are the rule rather than the exception. Also Neisser[7] has remarked that written letters and spoken syllables, the patterns we recognize most easily and commonly, fall into "ill-defined categories". It is notable that all these polymorphous concepts are generated by human behaviour; and in experiments on spontaneous classification, we have found that subjects use polymorphous rules quite freely. It seems extraordinary that such rules should be so hard to formulate. Yet there is no reason to think the difficulty is not general. We report here experiments using two different test procedures and three different sets of stimulus material; informal tests under the most varied conditions have always produced the same result. Nor is the difficulty entirely in the formulation of the rule: the trials-to-last-error measure used in experiment 1 does not involve explicit formulation. At the least, these experiments point to a difference between rules which are easy to use and those which are easily learned; it may be that this reflects a difference between rules which we generate spontaneously and those which we can extract easily from external problems. This would be evidence against the widely held theory of "analysis by synthesis" (see Neisser[7], page 161ff), which implies that rule discovery inevitably involves internal generation of a corresponding rule.

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Comment

THE preceding communication presents two experiments which investigate the ability of undergraduates to deduce and formulate a classification rule for three problem types. The performance of the subjects is described in terms of two quantitative measures—median number of cards exposed in experiment 1 and median time to solution in experiment 2. As the authors admit, however, the actual numerical values presented are rather misleading because subjects fail to achieve a solution. I cannot understand why the authors did not present detailed qualitative descriptions of the kinds of rules offered by the subjects in each task.

The chief conclusion of the communication is that in the experimental conditions used by Lea *et al.*, *m*-out-of-*n* polymorphous problems are very difficult to formulate. The authors remark, however, that some workers have claimed that polymorphous rules are those most frequently used in normal cognitive activity and they mention that they have obtained experimental evidence (in conditions which are not clearly specified) which suggest that subjects can and indeed do choose to use polymorphous rules frequently. It seems to me that the authors should ask themselves why, with their experimental procedure, instructions, and stimulus material, the subjects failed to show the supposed fluency with polymorphous problems. It is worth noting that several workers have remarked that we habitually categorize and assign structure to events using rules which we cannot formally define—see work on visual and auditory pattern recognition and interpretation, and linguistics.

Lea *et al.* argue that because they obtained their results using two "different" test procedures (by in fact varying the number of visible stimuli against which the subject could evaluate a rule), three different sets of stimuli (by varying the selection of relevant stimulus dimensions but not by sampling different classes of stimuli) and in informal tests under the "most varied conditions" (unspecified) there is no reason to doubt the generality of the finding. This statement may or may not be correct but the authors give little information with which to evaluate their claim. The authors finally suggest that the apparent conflict between their results and the supposed generality of polymorphous concepts may reflect the fact that polymorphous concepts are hard to learn but, once learned, are easy to use. The discussion which follows this remark contains a number of implicit assumptions which to my eyes move the discussion into the realms of the inscrutable.

The interest of the authors' claim must depend on how adequately an experimental procedure which involves the presentation of meaningless patterns yields a representative measure of the human capacity to deduce and test a conceptual role.

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