14. 1985.

15. Except that four subjects were unable to satisfactorily draw the slightly more complex 'Schroder staircase' figure from their images.

Notes to §II.B.6.

1. Rare exceptions are Lindauer [1969], Segal & Fusella [1971] and Juhasz [1969, 1972]. The Sheehan-Betts questionnaire on imagery vividness [Sheehan, 1967] asks about imagery in seven modes, but it seems to have been used less, and less successfully, than Marks' [1973] VVIQ questionnaire [Marks, 1983a; Sheehan, Ashton & White, 1983], which deals exclusively with the vividness of visual imagery. Philosophers make little better showing. Newton [1982], it is true, does argue that imagery from other sense modes may be very important. However, apart from her, to the best of my knowledge only Ryle [1949 chap.8] and some of those who are responding fairly directly to the relevant arguments he propounds [e.g. Matthews, 1969] have anything substantial to say about such non-visual imaginings.

2. That is not to say that you could not imagine both the sight and, say, the smell of something at the same time. But this could be interpreted as having two separate images (one visual, one olfactory) simultaneously. It does not have to be one unified image.

3. See §s I.C.3, 4 and 5 above.

4. Locke, 1700 Bk.II chap.9 §8. For the historical and philosophical background and consequences of this view see Morgan [1977]. Morgan argues that Locke's position can now be seen to have been mistaken [1977 p.207].

5. Blindness in a new born baby is not at all obvious. Thus there are very few people who can be reliably known to have been blind absolutely from birth. Thus the term "early blind" is often used in the literature in preference to "congenitally blind". However, is seems to be the case that children who lose their sight at anything up to five years of age quite quickly loose any ability to form mental images (those blinded later in life, however, may retain the ability to visualize for many years) [Schlaegel, 1953; Berger, Olley & Oswald, 1962; Kirtley, 1975]. Thus for our purposes no real distinction need be made between the early blind and true congenitals. I shall treat "congenitally blind" and "early blind" as synonymous.

6. Morgan, 1977.

7. I.e. their blindness might be caused by brain damage affecting these structures.

8. Paivio, 1971 p.518.

9. Paivio, 1971 p.518.

10. Paivio & Okovita, 1971.

11. 1973.

12. 1983 expt.1.

13. Zimler & Keenan, 1983 p.272.

14. 1975.

15. Jonides, Kahn & Rozin, 1975 p.426.

16. 1983 expt.3.

17. 1983 expt.3.

18. Neisser & Kerr, 1973; Keenan & Moore, 1979. Unfortunately, the results found in these earlier experiments on the sighted, and replicated in each case with early blind subjects, were not the same. Neisser & Kerr [1973] (and Kerr [1983]) found that 'concealed' objects in images were remembered just as well as 'visible' ones. Keenan & Moore [1979] (and Zimler & Keenan [1983]), by contrast, found that 'concealed' objects were not remembered so well as 'visible' ones. It is true that they gave their subjects much more vehement instructions on concealment, but Kerr & Neisser [1983] obtained their original result (with sighted subjects) even when they used identical instructions to Keenan & Moore. They could only obtain an effect of 'concealment' by putting their subjects under strong time pressure [Kerr & Neisser, 1983]. Keenan [1983], however, denies having put her subjects under such pressure. The situation is, then, not at all clear, and it looks suspiciously as if the sort of experimenter effects described by Intons-Peterson [1983] are playing a strong part. What we can say, however, is that for neither group of experimenters did the pattern of results differ as between blind and sighted subjects. Also, all involved agree that imagery has least mnemonic effect when the two objects to be associated are imagined as being in separated locations.

19. Well before the publication of the experimental evidence for imagery effects in the blind, Keilkopf [1968] argued that if we reject a picture theory of imagery then we will have no grounds for denying that the congenitally blind can have imagery just like that of the sighted.

20. 1971 - see §I.C.3 above.

21. These seemingly arose from a non-rotational strategy which was made possible by the simplicity of the shapes, and which some subjects reported using. When the

right hand shape was turned through 120° or 150° it could be considered as more or less 'upside down' (perhaps it was mentally rotated to an upside down position), and its similarity to the reference shape could be determined by noting whether the 'bite' taken out of the 'top' was on the same or the opposite side to that in the reference shape. If it was on the opposite side to its position in the reference shape then the two shapes must be identical, and vice-versa.

22. 1971; Metzler & Shepard, 1974.

23. Marmor & Zaback, 1976 p.250. Unfortunately, they do not make clear just how this information was elicited. One should no more presume that subjects who do not report using rotation do not in fact use it than one should take positive reports about rotation as proving that it really does take place.

24. 1980 p.324.

25. Kosslyn, 1980 p.301.

26. Just & Carpenter, 1976; Carpenter & Just, 1978.

27. Kosslyn, 1980 p.324.

28. See e.g. Kosslyn & Pomerantz, 1977 pp.67-9; Kosslyn, 1980 p.16, 1983 pp.38-9.

29. See Shepard & Cooper, 1982 pt.1.

30. Kosslyn, 1983 p.105.

31. 1978.

32. 1973 expt.1.

33. The experiment does not distinguish whether it is the image of the presented or of the remembered character which is rotated. But this is of little moment for us.

34. Carpenter & Eisenberg, 1978 p.121.

35. 1973 expt.1.

36. Even reproducing the departures from linearity found in that experiment [Cooper & Shepard, 1973]. (See §I.C.3 above.)

37. Carpenter & Eisenberg, 1978 p.124.

38. 1976.

39. 1983.

40. 1983 expt.1.

41. 1978 expt.2.

42. Kerr, 1983 p.268.

43. Kosslyn, Ball & Reiser, 1978 expt.1.

44. §I.C.4 above.

45. §I.C.5.

46. 1975 expt.1.

47. Kerr, 1983 expt.2.

48. 1976.

49. 1978.

50. 1983.

51. Von Senden, 1960 - original German, 1932.

52. See e.g. Rock [1966 p.235] and Warren [1970 pp.131-3]. The historical background to such views (and their converse, which have been the Empiricist philosophical orthodoxy since Berkeley) has been traced by Morgan [1977]. He suggests that it largely arises from the influence of the 'local sign' theory of Hermann Lotze, which itself rested on a misconstrual of Kant.

53. Brodey [1969] provides some excellent examples, and a vivid and fascinating evocation of the experiential world of the blind. Guaniero [1974] embodies another example.

54. 1978.

55. Casey, 1978 pp.300-301.

56. 1980.

57. Reiser, Lockman & Pick, 1980 p.185.

58. Reiser, Lockman & Pick, 1980 pp.189-90.

59. See Acredolo, 1983.

60. Landau, Gleitman & Spelke, 1981 p.1276.

61. Landau, Gleitman & Spelke, 1981 p.1275.

62. C.f. Cratty [1971 p.191]. For a recent theoretical discussion of blind people's understanding of environmental space see Strelow [1985].

63. 1976.

64. On the latter relation See Shorter [1952] and Richards [1977].

65. 1982.

66. Five of the blind subjects did not produce REMs [Kerr, Foulkes & Schmidt, 1982 p.287].

67. In fact only one of the subjects was totally blind. The other had some capacity to tell light from darkness, but not to discern forms [Kerr, Foulkes & Schmidt, 1982 p.287]. But this does not seem likely to be of relevance to her spatial imagery abilities.

68. Kerr, Foulkes & Schmidt, 1982 p.292.

69. 1980; Kennedy & Heywood, 1980; Kennedy & Gabias, 1985.

70. Kennedy, 1980 pp.297f.

71. See §I.C.2 above.

72. 1980.

73. 1967. See §I.C.2 above.

74. Baddeley & Lieberman, 1980 p.525.

75. Baddeley & Lieberman, 1980 expt.2. Baddeley does not, however, wish to conclude that the spatial and purely visual aspects of what he calls "working memory" require completely independent imagery systems [see Baddeley, 1986 chap.].

76. 1984.

77. Brooks, 1968. See §I.C.2 above.

78. Brooks, 1968. Except that no difference was observed by Hampson & Duffy [1984] between the effect on the verbal task of typing or saying the answers (tapping was faster than either). I would suggest that perhaps the typing response involves a verbal as well as a spatial component, in that one would have to think of "Y" for "yes" and "N" for "no".

79. A minor exception is that the sighted unblindfolded subjects were consistently (but non-significantly) slower than the others to perform the image task in all response modes. Hampson & Duffy speculate that this may be due to interference from actual visual inputs. On the other hand, informal observations which I made at U.C. Davis indicated that most people, explicitly given the choice, prefered to do imagery tasks with their eyes open.

80. Kosslyn, 1980 pp.323-4.

81. 1976.

82. Kennedy, 1980; Kennedy & Heywood, 1980; Kennedy & Gabias, 1985.

83. See Morgan, 1977.

Notes to §II.B.7.

1. 1969.

2. This is surely not very persuasive, and although Matthews develops the point in a far more satisfying way than I have had room to indicate here I remain unhappy with his argument. He seems not to have considered the possibility that imaging X might be thought of as (truly) seeing something-like-X. Of course, this cannot be strictly right because mental pictures are not physically in front of our eyes. But if the work of the eyes and any other stages of visual processing prior to image formation are thought to be relatively passive and simple, with most of the 'visual processing', the real meat of perception, going on **after** the image is formed, then it might perhaps reasonably be taken as a quite perspicuous characterisation of the situation. To put things another way, if the stage of processing where imaging takes place is sufficiently peripheral, if the informational content of some 'visual buffer' is not too far removed from the sometime informational content of the retinal image itself, then a quasi-pictorial image would clearly have a functional rôle, if only as a 'way-station' in perception (the extreme case of this is the TV-hood model discussed in §II.B.3). **Descartes'** model really is like this, and Kosslyn's model, I believe, derives much of its plausibility from appearing to be this way. The problem for Kosslyn is that the data on "cognitive penetration" of imagery is only to be dealt with by postulating considerable 'pre-processing' of the image, which thus **cannot** be very peripheral. Kosslyn's defence of quasi-pictorialism depends on the ambiguity in his model which allows him to slide between an implicitly fairly peripheral 'visual buffer', where an image could plausibly be quite picturelike, and an implicitly fairly central one, where the functional information (according to standard cognitivist tenets) should have an essentially 'propositional' or descriptional character (and so can be 'penetrated' by other 'propositional' beliefs). Matthews' argument on its own seems to leave the peripheralist option open.

3. See **De Rerum Natura. Liber IV** lns.722-48 [Bailey, 1947].

4. Matthews, 1969 p.69. Matthews does **not** endorse this theory. Note that the evidence from the congenitally blind would also seem to contradict its first premise.

5. Bower, 1972 p.56. Although Bower seems to have been a pictorialist when this paper was first written and presented he later espoused a descriptionist position [Anderson & Bower, 1973 pp.449-461]. (Anderson by contrast has since moved some way towards pictorialism [Anderson, 1978, 1983].

6. See Matthews [1969 §IV] for other objections to the theory.

7. 1974.

8. 1977.

9. In any case, there is independent physiological evidence for the point [Gazzaniga & LeDoux, 1978 p.122].

10. Kosslyn & Pomerantz, 1977 p.57.

11. C.f. Anderson, 1978.

12. Kosslyn & Pomerantz, 1977 p.59. This is also intended to help answer Pylyshyn's [1973] point that storing unprocessed images in memory would quickly overburden the storage capacity of the brain.

13. Inner 'language of thought' models seem to require innate concepts in any case [Fodor, 1981a chap.10; 1975]. If we can swallow that why not swallow innate image parts along with them? It is hard to see how else they could arise.

Notes to §II.C.1.

1. Shorter, 1952 p.538f.

2. See §II.B.4 above. Shorter's claim that the analogies between "visualising" and both "describing" and "depicting" are closer and less misleading than those between "visualising" and "seeing" is surely very much open to question [see Flew, 1956; Hannay, 1971 chap.III].

3. 1969 pp.135f. A very similar argument is set out in rather greater detail by Runzo [1977], but this discussion is too late to in any way anticipate much more concrete formulations of 'descriptionism' in the literature of Cognitive Science.

4. Dennett is manifestly highly uncomfortable with the theory, and elsewhere in the same work [1969 pp.86f] and later [1978 chaps. 3 & 6] he is highly critical of the "brain writing" idea. Nevertheless, he would seem to be even less comfortable with pictorial theories.