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in the way in which observational learning may occur. I propose that a closer examination of the mechanism by which both infants and adults learn through observation may yield new insights into the nature of human memory development.

References

Barr, R., Dowden, A., & Hayne, H. (1996). Developmental changes in deferred imitation. *Infant Behavior and Development*, **19**, 159–170.

Barr, R., & Hayne, H. (2000). Age-related changes in deferred imitation: implications for memory development. In C. Rovee-Collier, L. Lipsitt & H. Hayne (Eds.), *Progress in infancy research (Vol. 1)* (pp. 21–67). Mahwah, NJ: Erlbaum.

Bellagamba, F., & Tomasello, M. (1999). Re-enacting intended acts: comparing 12- and 18-month-olds. *Infant Behavior and Development*, **22**, 277–282.

Collie, R., & Hayne, H. (1999). Deferred imitation by 6- and 9-month-old infants: more evidence for declarative memory. *Developmental Psychobiology*, **35**, 83–90.

Hanna, E., & Meltzoff, A.N. (1993). Peer imitation in laboratory, home and day care contexts: implictions for social learning and memory. *Developmental Psychology*, **29**, 1–12.

Hayne, H., Boniface, J., & Barr, R. (2000). The development of declarative memory in human infants: age-related changes in deferred imitation. *Behavioral Neuroscience*, **114**, 77–83.

Hayne, H., MacDonald, S., & Barr, R. (1997). Age-related changes in the specificity of memory retrieval: implications for cognitive development. *Infant Behavior and Development*, **20**, 233–245.

Herbert, J., & Hayne, H. (2000a). The ontogeny of long-term retention during the second year of life. *Developmental Science*, **3**, 50–56.

Herbert, J., & Hayne, H. (2000b). Memory retrieval by 18- to 30-month-olds: age-related changes in representational flexibility. *Developmental Psychology*, **36**, 473–484.

Klein, P.J., & Meltzoff, A.N. (1999). Long-term memory, forgetting, and deferred imitation in 12-month-old infants. *Developmental Science*, **2**, 102–113.

McDonough, L., Mandler, J.M., McKee, R.D., & Squire, L.R. (1995). The deferred imitation task as a nonverbal measure of declarative memory. *Proceedings of the National Academy of Science*, **92**, 7580–7584.

Meltzoff, A.N. (1985). Immediate and deferred imitation in 14- and 24-month-old infants. *Child Development*, **56**, 62–72.

Meltzoff, A.N. (1988a). Infant imitation after a 1-week delay: long-term memory for novel acts and multiple stimuli. *Developmental Psychology*, **24**, 470–476.

Meltzoff, A.N. (1988b). Infant imitation and memory: nine-month-olds in immediate and deferred tests. *Child Development*, **59**, 217–225.

Meltzoff, A.N. (1995). Understanding the intentions of others: re-enactment of intended acts by 18-month-old children. *Developmental Psychology*, **31**, 838–850.

Distinguishing intention-sensitive from outcome-sensitive imitation

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Developmental and comparative research on social learning will both be enriched by the kind of integrative analysis presented by Want and Harris. They have provided an accurate summary of the principal theoretical distinctions currently used in research on nonhuman primates, and applied these to the developmental literature in a way that yields clear hypotheses and preliminary conclusions about social learning in childhood. One of the most general of these conclusions is that children begin to show imitation, defined as the reproduction of a model's acts guided by recognition of the model's goal or intention, at about 18 months. We question this conclusion, and in the process seek to broaden the synthesis by drawing developmentalists' attention to research on social learning in human adults and in non-primate species.

Primate researchers are somewhat idiosyncratic in their use of the term 'imitation'. In other areas of comparative psychology (e.g. Akins & Zentall, 1998; Lefebvre,

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Templeton, Brown & Koelle, 1997; Heyes & Ray, 2000), as in social psychology (e.g. Chartrand & Bargh, 1999) and cognitive neuroscience (e.g. Grezes, Costes & Decety, 1998, De Renzi, Cavalleri & Facchini, 1996), imitation is a descriptive, rather than an explanatory, term, and it refers to a wider range of phenomena (Heyes, 2001). It is applied to all cases in which it has been established that one individual has copied the body movements of another, and questions about how this copying was achieved, questions about mechanism, are left for separate resolution. In contrast, primate researchers, following Tomasello (e.g. Tomasello, Kruger & Ratner, 1993), reserve 'imitation' for body movement copying guided by attribution of a goal or intention to the model, and contrast it with 'mimicry', in which body movements are copied without understanding of the model's goal.

One problem with this imitation-mimicry dichotomy is that it conceals an adaptive, and possibly a common, variety of social learning / imitation: body movement copying that is guided by observation of the physical *outcome* of the model's behaviour, but not by the attribution of any goal or intention to the model. We will call this 'outcome-sensitive imitation', and contrast it with 'intention-sensitive imitation', i.e. what Want and Harris, following primate researchers, call simply 'imitation'. As a hypothetical example of outcome-sensitive imitation, imagine yourself standing in line to use an unfamiliar vending machine and seeing the person ahead of you press three buttons, thump the cabinet, and receive a Diet Coke. If you want a Diet Coke, you may copy the model's body movements, regardless of whether you judge the model to have got what he or she wanted, or, indeed, even if you haven't bothered to attribute any intentions at all to the model.

Akins and Zentall (1998) have provided a real-life example of outcome-sensitive imitation in their research with Japanese quail. When these birds observe a conspecific model pecking or stepping on a lever for food reward, the observers subsequently copy the model's behaviour; those that saw pecking, peck the lever, and those that saw stepping, step on the lever. However, when the model is observed labouring away, pecking or stepping, without any reward, the observer's subsequent choice of response topography is not influenced by that of the model.

We believe, in contrast with Want and Harris, that the evidence currently available does not demonstrate intention-sensitivity in infants' imitation, although it may indicate outcome-sensitivity. The two studies which come closest to demonstrating intention-sensitive imitation are by Meltzoff (1995) and Carpenter, Akhtar and Tomasello (1998). Meltzoff's (1995, Experiment 1) first finding was that 18-month-old infants are as likely, for example, to pull apart a dumbbell when they have observed an adult trying and failing to pull it apart, as when they have seen the adult successfully separating the two parts of the toy. This could be because the infants inferred the unsuccessful model's intention (the intention-sensitive interpretation), or it could be because both groups saw a model applying outward pressure to the two parts of the dumbbell, and faithfully replicated this observed movement. Meltzoff's (1995, Experiment 2) second finding was that 18-month-olds are less likely to pull apart the toy when they have seen mechanical pincers 'trying and failing' to pull it apart, than when they have seen a human adult doing the same. This result was interpreted as support for the intention-sensitive interpretation of the first finding, but it is flawed. The infants who saw the pincers contacting the toy simultaneously saw an adult standing behind the mechanical device and resolutely not touching the dumbbell. Therefore, it is plausible that the infants in the pincer group were less likely to pull apart the toy than those who saw the human model manipulating the dumbbell, not because the former did and the latter did not attribute an intention to the model, but because the pincer group copied their passive human model by inhibiting all contact with the dumbbell.

Carpenter *et al.* (1998) showed that 14- to 18-month-olds are more likely to copy acts that are followed by the model saying 'There!', than by acts that are followed by the model saying 'Whoops!' These vocalizations are interpreted by adult speakers of English as indicators that the foregoing action was intentional / deliberate and accidental, respectively, but their modulation of infants' imitative performance does not establish that infants interpret them in the same way. It is plausible that, before they understand desire or intention, toddlers learn that imitation of actions that were accompanied by the sound 'Whoops!' is less likely to have rewarding consequences (e.g. interesting sensory stimulation, adult approval) than imitation of actions that are followed by 'There!' Consequently, like other, similar experiments (e.g. Carpenter, Nagell & Tomasello, 1998), the study by Carpenter *et al.* suggests that infants' imitative performance is modulated by observed sequels or consequences of the model's act, that it is outcome-sensitive, but does not securely demonstrate that it is intention-sensitive, guided by the attribution of goals or purposes to the model.

In summary: We applaud Want and Harris's integrative approach, but, in contrast with them, we think that the currently available evidence provides no reliable indication of when children begin to show intention-sensitive imitation. On a more strategic level, we would recommend that, in pursuing Want and Harris's integrative agenda, developmentalists (1) avoid treating

'imitation' as the name of a psychological mechanism – as an explicans, rather than an explicandum, and (2) resist the tendency, fostered by primate researchers' mimicry-imitation dichotomy, to conflate as 'goals' a model's intention and the observable outcome of his or her action.

References

Akins, C.K. and Zentall, T.R. (1998). Imitation in Japanese quail: the role of reinforcement of demonstrator responding. *Psychonomic Bulletin and Review*, **5**, 694–697.

Carpenter, M., Akhtar, N., & Tomasello, M. (1998). Fourteen- through 18-month-old infants differentially imitate intentional and accidental actions. *Infant Behavior and Development*, **21**, 315–330.

Carpenter, M., Nagell, K., & Tomasello, M. (1998). Social cognition, joint attention and communicative competence from 9 to 15 months of age. *Monographs of the Society for Research in Child Development*, **63** (255).

Chartrand, T.L., & Bargh, J.A. (1999). The chameleon effect: the perception-behavior link and social interaction. *Journal of Personality and Social Psychology*, **76**, 893–910.

De Renzi, E., Cavalleri, F., & Facchini, S. (1996). Imitation and utilisation behaviour. *Journal of Neurology, Neurosurgery and Psychiatry*, **61**, 396–400.

Grezes, J., Costes, N., & Decety, J. (1998). Top-down effect of strategy on the perception of human biological motion: a PET investigation. *Cognitive Neuropsychology*, **15**, 553–582.

Heyes, C.M., & Ray, E.D. (2000). What is the significance of imitation in animals? *Advances in the Study of Behavior*, **29**, 215–245.

Heyes, C.M. (2001). Causes and consequences of imitation. *Trends in Cognitive Sciences*, **5** (6), 253–261.

Lefebvre, L., Templeton, J., Brown, K., & Koelle, M. (1997). Carib grackles imitate conspecific and zeneida dove tutors. *Behaviour*, **134**, 1003–1017.

Meltzoff, A.N. (1995). Understanding the intentions of others: re-enactment of intended acts by 18-month-old children. *Developmental Psychology*, **31**, 838–850.

Tomasello, M., Kruger, A.C., & Ratner, H.H. (1993). Cultural learning. *Behavioral and Brain Sciences*, **16**, 495–552.

Primatology and developmental science: who's aping whom?

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Want and Harris offer a timely bridge between recent work on social learning in apes and the surprising gaps in our knowledge of similar phenomena in children. I agree about the gaps, recently concluding that 'by the standards of evidence debated in the recent literature on the question of animal culture (e.g. Galef, 1992; Heyes & Galef, 1996), we seem to have remarkably little systematic evidence on just how much of the behaviour of humans in any society is socially transmitted'! (Whiten, 1999). The study of language acquisition is a noble exception, but Want and Harris are surely correct that its counterpart, 'technology acquisition', still begs proper study, and the multidisciplinary renaissance in social learning research (e.g. Meltzoff and Prinz, in press; Dautenhahn and Nehaniv, in press) means the time is ripe for developmental science to play its part. This article lays important foundations.

Yet I feel Want and Harris ascribe both too little and too much to the contribution of comparative studies: too little because animal scientists' dissection of social learning is more complex than they portray; and too much, because experiments discriminating some of the key principal conceptual distinctions remain as rare for apes as for children.

Coming full circle

From the perspective of developmental science, it is worth noting that the concept of emulation, which Want and Harris present as a concept elaborated in recent comparative psychology and now worthy of note by developmentalists, came originally from the latter: specifically, David Wood (1989, p. 71) had suggested that 'children

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