Imitation, Skill Learning, and Conceptual Thought: An Embodied, Developmental Approach

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Abstract It is the goal of this chapter to offer a strategy for moving from imitation to conceptual thought. First, I accept that imitation plays a vital role in accounting for the facility with which human beings acquire abilities, but I argue that successful task performance is not identical to intelligent action. To move beyond first-order behavioral success, I suggest that the orientation that humans have toward the means of intentional actions, that is, the orientation required for imitation, also drives us to perfect our skills in a way that produces fertile ground for florid thought.

In Section "What Is So Special About Human Imitation?", I propose that the difference between animal and human copying lies in what I call the "means-centric orientation." In Section "Imitation Is Great, but It Ain't Everything", I explore three characteristic features of intelligence and claim that the first-order behavioral success that results from imitation is not characterized by these features. In the final section of this chapter, I argue that the means-centric orientation, when inverted onto itself, motivates skill refinement and, as such, allows us to reach the intermediate level of cognitive development. It is at this level, through the individuation and recombination of action elements, that we see a basic syntax of action arise and, with it, the characteristic features of intelligence emerge.

1 Introduction

In the search for that special something that might account for the difference between human cognition and the cognition of nonhuman animals, imitation has received a lot of attention. This is especially true in developmental and social psychology

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circles where imitation, an arguably unique human capacity, has been deemed crucial to the development of social cognition and higher-order executive function (Tomasello et al. 2005; Tomasello and Rokoczy 2003; Meltzoff 2005). It is thought that imitation fosters in humans the capacity to form tight social bonds, to share in joint attention, joint action, linguistic communication, shared intentionality, an understanding of other minds, and finally, an understanding of ourselves. These interpersonal connections are meant to pave the way to full-fledged, florid, higher-order, human-style thinking. The problem remains, however, that it is not at all obvious how imitation alone is going to guide us into these lofty cognitive realms.

In this chapter, my goal is to offer a theoretical strategy for moving from imitation to conceptual thought. After accepting that imitation plays a vital role in accounting for the facility with which human beings acquire abilities, I argue that successful task performance is not identical to intelligent action. To move beyond first-order behavioral success, I suggest that the motivation driving imitation, when applied intrapersonally, acts as a parsimonious and powerful force. Specifically, I argue that the orientation that humans have toward the means of intentional actions, that is, the orientation that drives imitation, also propels us to perfect our skills in a way that produces fertile ground for florid thought. I develop this account by presenting a theory that grounds the flexibility, manipulability, and transferability of mature human cognition in embodied skill.

In Sect. 2, I propose that the difference between animal and human copying lies in what I call the "means-centric orientation." In Sect. 3, I explore three characteristic features of intelligence and claim that the first-order behavioral success that results from imitation is not characterized by these features. In the final section of this chapter, I argue that the means-centric orientation, when directed at one's own actions, motivates skill refinement and, as such, allows us to reach the intermediate level of cognitive development. It is at this level, through the individuation and recombination of action elements, that we first see a basic syntax of action arise and, with it, the characteristic features of intelligence emerge.

2 What Is So Special About Human Imitation?

Everyone involved in the imitation debate agrees that human imitation is special. By this, I do not mean to suggest that there is a lack of disagreement about whether imitation is an exclusively human affair.[1] My point is, rather, that even those who deny that imitation is proprietary to humans admit that human imitation is importantly distinct from the imitation of nonhuman animals.[2] Notably, nonhuman

[1] For instance, Tomasello (1996, 1999; Call and Tomasello 1998) claims that imitation is proprietary to humans, while others (Byrne 2002; Horner and Whiten 2005) claim that imitation can be observed in the behavior of nonhuman primates.

[2] For an instance of such a position, see Byrne and Russon's (1998) distinction between action and program-level imitation.

primates, our closest evolutionary relatives, neither imitate as often as human children nor do they reproduce the particular detailed style with which an observed action is instantiated (Byrne 2002; Byrne and Russon 1998; Call et al. 2004; Tomasello 2009). Additionally, the role of imitation in cultural learning and transmission has no comparable function anywhere outside of human society (Tomasello 2005; Boesch and Tomasello 1998; Tomasello and Rokaczy 2003). As such, even if some nonhuman animals are found capable of imitation, we will still need an account of human imitation that explains its prominence and uniqueness as a learning strategy for children.

2.1 Reworking the Definition of Imitation

In this section, my goal is to argue that the means or instrumental strategy of goal-directed actions plays an essential role in forming the intention motivating imitation. In this sense, I'd like to amend the preferred definition of imitation by highlighting the significance for the imitator of the instrumental strategy with which an observed and reproduced action is instantiated. In particular, I suggest that the efficient cause of imitation, that is, the reason why an individual imitates, is fundamentally connected to the imitator's irreducible interest in or concern for the means of an observed intentional action. I call this general perspective "the means-centric orientation."

The means-centric orientation is best understood as the not-merely-instrumental interest in or preference for the means of an intentional action. Specifically, my claim about the means-centric orientation amounts to the following: when a subject S imitates some action A, which is aimed at accomplishing a goal G, it is both the means M that are used to accomplish G and G itself that hold inherent value for S. For example, if an agent models for a child how to open an umbrella, both the end of opening the umbrella and the means that the model uses to open the umbrella become objects of intrinsic concern for the child who imitates.

Importantly, the means-centric orientation turns the means of goal-directed actions into a locus of significance. It makes the means of an observed and imitated action important and interesting in their own right; it makes the details of an observed behavior contain value that is not necessarily reducible to its practical payoff or purpose. This is not to say that the "not-merely-instrumental" concern for means is necessarily reducible to the means themselves, but it is to say that the value of means overflows their capacity to facilitate goal satisfaction.[3] Notably, focusing on this aspect of imitation also allows me to present a clear strategy for relating imitation to higher-order cognition in later sections of this chapter.

[3] I use "not-merely-instrumental" value and not simply "inherent" value in order to leave open the possibility that means are a locus of value or significance as a result of their role in offering opportunities for social connection and intersubjective rewards. In this sense, the concern for means would be not-merely-instrumental for the goal at hand, but still offers other kinds of important payoffs.

To be clear, I understand my emphasis on the means-centric orientation as compatible with conventional definitions of imitation. In fact, if we take Michael Tomasello's definition of imitation, the means-centric orientation should be seen as a refinement and not a replacement of it. Boesch and Tomasello write that the "the archetype of imitative learning… [is the] reproduction of both behavior and its intended result" (1998, p. 599). This definition of imitation requires that the imitator exhibits sensitivity both to the goals of the observed demonstration and also to the particular behavioral strategy that the model uses in order to achieve her goals.[4]

To better understand the nature of imitation, and why my proposed amendment is necessary, it may be helpful to contrast it, as Tomasello famously does, with emulation.[5] Boesch and Tomasello define emulation as "the process whereby an individual observes and learns some dynamic affordances of the inanimate world as a result of the behavior of other animals and then uses what it has learned to devise its own behavioral strategies" (1998, p. 598). For Tomasello, the primary distinction between imitation and emulation is that imitation requires the imitator to recognize and reproduce the intentional goal state of the demonstrator, while emulation only requires reproducing the observed behavior in order to manipulate the world. What Tomasello overlooks, however, by focusing on the shared psychology of imitator and demonstrator is the fact that an imitator must show concern not only for the mental states of the demonstrator but also for the actual actions that the demonstrator performs.[6] That is, the imitator can not only be interested in the intentional constitution of the demonstrator but must also be interested in the task or action that the demonstrator models. To reflect this point, on my account, imitation learning differs from emulation learning in two ways: (1) in sharing a goal with the demonstrator, and (2) in expressing a noninstrumental preference for reproducing the behavioral strategy that the demonstrator models.

We should note that while for Tomasello the particular details of an observed behavior must be reproduced in order for some action to count as imitation, he does not require that the imitator have a special interest in or intention for reproducing the behavior.[7] In contrast, on my account, it is not simply that the imitator happens

[4] Importantly, studies on rational imitation show that it is not just movements, but actions that are recognized as intentional, which are imitated by children. See Meltzoff (1995); Carpenter et al. 1998; Bellagamba and Tomasello 1999; Gergely and Csibra(2005); Schwier et al.(2006).

[5] Tomasello (2009) has now admitted that, in rare cases, nonhuman primates do in fact imitate. However, he still holds that in most circumstances, the copying behavior of nonhuman primates is emulation and not imitation.

[6] In fact, ideally, the interest in the action should form the path by which the imitator can learn about intentional states. She should not already know about the demonstrator's mental states if imitation is meant to be a strategy by which she is going to learn about them. See Meltzoff (2005) for a defense of this position.

[7] To be fair, in 2009, Tomasello has written that a concern with action itself may be crucial for differentiating between animal and human copying. This admission, however, is not reflected in a new definition of imitation. As such, my proposal constitutes a significant change in what is taken to be necessary for imitation.

to reproduce the same behavioral sequence that the model demonstrates as a result of sharing a goal with the demonstrator, but that the imitator's reason for producing the behavior makes the reproduction of the observed behavior part of the goal of her action—it becomes part of the intentional state driving imitation. In short, the means-centric orientation drives imitation by making sure that the imitator has the reproduction of the means of an observed action incorporated into her objective for acting.

As such, this preoccupation with the means of action poises humans for imitation by overriding the more pragmatic concerns of action, such as implementing whichever strategy will most efficiently lead to the satisfaction of one's desires. The saliency of the means of action keeps humans focused on and attentive to the instrumental strategy of an observed action rather than on the world or the goal at which the action is aimed. And this keeps us hooked specifically on imitation in a way that simply sharing goals with a demonstrator cannot.[8] It keeps us reproducing the detailed, particular strategies that we see others perform because it is the means by which we achieve our goals, and not only the goals, that are interesting and meaningful for us.

2.2 Empirical Evidence of the "Not-Merely-Instrumental" Preference for Means

Happily, empirical research on imitation supports my claim that humans have a not-merely-instrumental preference for the means of intentional action. A great many studies have clearly demonstrated that humans imitate regardless of whether imitation produces the most efficient route for achieving an end. I will present just one of these studies here.[9]

In a particularly elegant study, Victoria Horner and Andrew Whiten (2005) presented chimpanzees and 2-year-old human children with a demonstration of a complex sequence of actions aimed at opening a box containing a food reward in two conditions: one opaque and one transparent. In the opaque condition, the causal structure of the interaction between the experimenter and the box was hidden from the subjects, and so, when the demonstration included a causally irrelevant behavior, the subjects were unable to see it as such. Alternatively, in the transparent condition, the subjects were able to see how the experimenter's actions were causally related to the opening of the box. Horner and Whiten found that chimpanzees reproduced the observed behavioral sequence, including the useless movement, in the opaque condition but not in the transparent condition. That is, once the

[8] After all, the sharing of goals with another person may lead to numerous kinds of behaviors that are neither identical to nor connected with imitation.

[9] In addition to this study, especially notable is the work of Gergely and Csibra (2005).

chimpanzees determined that the movement was causally irrelevant for opening the box, they no longer incorporated that movement into their behavioral repertoire.

In contrast, children continued to reproduce the causally irrelevant action in both the opaque and the transparent condition. That is, even after identifying a movement as causally irrelevant, children continued to reproduce it when opening the box. Importantly, both chimpanzees and humans, in separate experiments, were shown to have the capacity to appreciate the relevance of causal information for achieving some end. These findings then clearly demonstrate that children will imitate even when imitation is not the most efficient way for them to achieve their goals. Further, this is not at all an isolated result. Children regularly display their impractical orientation toward imitation. This is especially evident in children's imitation and over-imitation of the detailed style with which an action is performed, a feature that is often completely irrelevant for task success (Byrne 2002, Lyons et al. 2007; McGuigan et al. 2007; Whiten et al. 2009).

The take-home point is this: for children, but not for nonhuman primates, the reproduction of the means of an observed action has a value that is not simply reducible to its value as a means to an end. Whatever else is true about the ultimate explanation of this orientation, we must admit that humans imitate as a result of a not-merely-instrumental preference for reproducing an observed behavior. This must be the case because if the value of reproducing an observed action were only instrumental, then when some means did not serve as the most efficient path to a goal, it would be abandoned. Since this does not always happen,[10] we must conclude that human beings have some interest in reproducing means, which is divorceable from the role of those means as a strategy for achieving some end. And it is precisely this nonstandard preoccupation with means, I claim, that gives us insight into what is special about the copying behavior of children.

2.3 A Few More Considerations

I hope to have shown that a preoccupation with the means of goal-directed actions is central to explaining the motivational structure that drives imitation. My claim is that by not acknowledging that means themselves enjoy a certain kind of impractical celebrity as part of the intentional content driving imitation, we overlook a crucial aspect of imitative behavior.

Lastly, we should note that it is thoroughly surprising when compared to the rest of the animal world that the human concern for action is often not reducible to the goal at which the action is aimed. This imprudence, this impracticality, I claim, is what makes human imitation special. Notably, this orientation can also explain the curiously impractical nature of many human activities. After all, it is only humans

[10] Of course, there will be times when humans are concerned with the goals of an action more so than with the means of that action. The main point, however, hangs on the fact that humans are *not always* so concerned with action, while nonhuman primates are.

that spend vast amounts of time and energy pursuing hobbies and skills that have no obvious evolutionary payoff. Think of playing video games, crocheting, creating miniatures, or solving a Rubik's cube puzzle with one's feet.[11] Only humans spend countless hours practicing and perfecting abilities and skills that are, on almost any practical measure, useless. On my account, the reason for this odd human characteristic is easy to explain. After all, a not-merely-instrumental preference for the means of intentional behavior accounts for why so many different activities could themselves become sources of interest, curiosity, and pursuit.

3 Imitation Is Great, but It Ain't Everything

In this section, my goal is to elucidate that the development of many features characteristic of human-level cognition cannot be accounted for with imitation or shared intentionality alone. My goal is not to downplay the importance of imitation in human cognitive development, but merely to highlight the additional work that needs to be done if we are going to be able to establish anything resembling a full account of human cognition.

First, it is vital to recognize that imitation is a great way to account for the transmission of highly complex and idiosyncratic practical and cultural knowledge. By imitating, humans acquire a huge number of skills that target the very specific needs of our geographical and historical situations. In fact, there seems to be no better way to transmit the infinite variety of methods required to master technology, ritual, and culture than to provide an innate "do as I do" mechanism (Meltzoff 2005). The problem, however, is that this mechanism alone cannot breed higher-order cognition. That is, imitation can account for task success and even cooperative, shared action, but it isn't obvious how either of these is meant to produce *our* kind of cognition.

3.1 Imitation: Task Success and Understanding

One of the most obvious examples of imitation's insufficiency for explaining the emergence of human understanding and intelligence comes from the fact that children are capable of imitating long before they are capable of understanding how their imitated actions are related to the world. The fact is that children can successfully act on objects in their environment by using an imitative strategy without thereby understanding much about the nature of the objects on which they are acting. For instance, Want and Harris (2001) show that at age two, children "blindly imitate," while by the age of three, they imitate in an "insightful" fashion. Want and Harris

[11] Yes, people actually do this and hold competitions!

establish this conclusion by demonstrating that 3-year-olds benefit from observing a mistaken or incorrect action while 2-year-olds do not. Thus, they reasonably conclude that only 3-year-olds imitate in a way that reveals an understanding of the causal relations between their actions and the environment.

Importantly, if successful imitation exists in the absence of task-specific knowledge, then we must conclude that, developmentally, imitation alone is not sufficient for understanding. This does not mean that imitation doesn't offer us a parsimonious strategy to gain such knowledge, but it does mean that imitation must be coupled with additional mechanisms, if it is to do any cognitive work. That is, imitation must work in conjunction with other cognitive learning processes if it is to account for our knowledge of objects, the environment, the self, others, and the causal and conceptual connections between these.

The mechanisms of imitation, if they are to provide us with the powerful tools that many theorists think they can, must be cashed out in such a way as to make clear how the appropriate connections, associations, and causal structures are formed as a result of their implementation. If imitation is to get us to knowledge, then imitation must work together with processes that can gather and connect the right kind of information with the right kinds of expectations.

We should notice, however, that these kinds of connections, associations, and expectations alone do not even begin to approach what is unique about human cognition. After all, the requirement for basic learning mechanisms will most certainly be held in common with nonhuman animals. Even emulation learning, after all, requires the subject to develop an understanding of environmental features and their causal affordances. Whatever accounts for that, coupled with imitation, should suffice for a basic explanation of "insightful imitation," or imitative learning that yields an understanding of the causal structure of the environment. Further, by focusing on the requirement that imitation is rational (Meltzoff 1995; Carpenter et al. 1998; Bellagamba and Tomasello 1999; Gergely and Csibra 2005; Schwier et al. 2006), we can even accept that imitation lays the groundwork for a basic understanding of other minds. But even if this then allows for shared attention, cooperation, and joint action, it still isn't clear how these are sufficient to explain the fantastic heights that we reach in abstract, conceptual thought?

That is, what should we say about our human cognitive capacities that go well beyond learning about the causal structure of the world or the recognition of actions as intentional? How might imitation be involved in the flexibility, manipulability, and transferability of human thought, our fine-grained recombinatorial abilities, our capacity for meta-representation, or the development of a sense of agency? Is it at all possible that this lofty grab bag of cognitive virtues has any connection to imitation? Before offering some guidance on how such a connection might be established, I'd like to take a moment to clarify how the above-listed capacities are distinguishing characteristics of human thought and also to elucidate why imitation, even if it can foster cooperative action and shared intentionality, cannot give us an explanation of them.

3.2 Intelligence and the Three Sisters: Flexibility, Manipulability, Transferability

Flexibility, manipulability, and transferability are related concepts that highlight important features of intelligence. In this section, I attempt to give an overview of the contributions that each makes to the notion of intelligence and also, where necessary, to point out the conceptual connections between them.

3.2.1 Flexibility

As we begin to consider some of the key features of human intelligence, flexibility quickly comes to mind. It seems that a behavior, no matter how sophisticated, which is rote, rigid, or inflexible, could not possibly qualify as intelligent. In fact, definitionally, intelligence is often contrasted with fixed, automatic, or stimulus–response behaviors. As José Bermúdez writes, "a distinguishing mark of the cognitive is that it is variant, and not stimulus–response" (2003, p. 8). He contrasts this with cognitively integrated "behavior that is flexible and plastic and tends to be the result of complex interactions between internal states learning and adaptation contributing and determining present responses" (Bermúdez 2003, p. 9). It follows that a lack of flexibility undermines the possibility of a behavior qualifying as genuinely intelligent. But what constitutes the special relationship between flexibility and intelligence? Is all flexible behavior intelligent? Could unintelligent behavior be flexible? After only a moment's consideration, I think that we will all agree that the answer to the first question is "no" and to the second, "yes."

After all, a random behavior or event, though it might be flexible to the point of being unpredictable, carries no guarantee of intelligence. Shouting the lyrics to a Dylan song in the middle of the library might not be something that is fixed in your instinctual behavioral repertoire, but that doesn't make it smart. The fact is that intelligence presupposes a degree of freedom, but it also requires a healthy dose of constraint. This is because intelligence is about doing the right thing at the right time and not just about doing anything whatsoever.[12] So, intelligent behavior must be simultaneously flexible and grounded. Intelligent behavior must be variable within the confines of the environment, a creature's goals, and the possibilities for instrumental action afforded thereby.[13] If this is correct, then we see that flexibility

[12] Dennett makes a similar point when he says that "The criterion for intelligent storage is then the appropriateness of the resultant behavior to the system's needs given the stimulus conditions of the initial input and the environment in which the behavior occurs" (1969, p. 50).

[13] There are obvious parallels to the point that I am making here and Hume's classic compatibilist critique of liberty (1961, section VIII). That is, as Hume points out, being free, uncaused, or random cannot ground responsibility since one cannot be responsible for a random or uncaused event.

isn't sufficient for intelligence, but merely necessary for the kind of behavioral changes about which we care. Namely, it is a prerequisite for appropriateness, learning, improvement, adaptation, and success. And we take these processes to be indicative of intelligent systems.

As such, we should conclude that flexibility is not by itself a mark of intelligence, but rather a sort of pointer to it. Flexibility's value is derived from the role that it plays in affording the possibility for a certain kind of behavior, namely, for affording the possibility of appropriate behavior in response to changing environmental conditions.

3.2.2 Manipulability

In addition to flexibility, manipulability is often cited as a characteristic of intelligent behavior. Manipulability requires a certain kind of flexibility, since that which is to be manipulated cannot be fixed; however, manipulability demands something more as well. Manipulability highlights the fact that when we speak of intelligence, we want behavior that is not only flexibly related to the world but flexible as a result of its being under the control of an agent. As such, the flexibility required for appropriate environmental responses, learning, and improvement should not just result from various parallel processes, but it should be hierarchical; it should be top-down. Intelligent behavior is behavior that an agent can access. It is behavior that an agent plans, organizes, reorganizes, guides, and controls.

Jesse Prinz (2004) [14] goes so far as to *define* cognition in terms of this kind of control, and Richard Byrne and Anne Russon write

> [W]e would be reluctant to describe as intelligent any sequence of behavior whose mental organization is a single unit or action connected to a goal representation, a long sequence of linear associative connections or a rigid hierarchical structure. Thus whether a behavioral structure is modifiable by the individual becomes crucial in diagnosing it as "intelligent." (1998, p. 671)

One crucial implication that follows from the requirement that intelligent behavior be manipulable is that intelligence becomes a personal-level phenomenon. That is, though it is possible that subpersonal systems respond flexibly to various environmental and internal circumstances, they are ruled out as intelligent because they are not under the control of an agent. The requirement that intelligent systems be manipulable entails that intelligence is a phenomenon that occurs on the level of

The connection between the agent and the action must be fundamental if agents are going to be responsible for their actions. Likewise, being flexible is not enough for being intelligent, but behaviors must be connected to their environments in the right way if these behaviors are to qualify as intelligent.

[14] Prinz writes that "[c]ognitive states and processes are those that exploit representations that are under the control of an organism rather than under the control of the environment" (2004, p. 45).

persons and not subsystems precisely because the kind of control demanded here is only available to whole agents. As such, we see that intelligence requires central integration that is impossible at lower levels of cognitive processing.

As a brief aside, I'd like to point out that at this stage, we are not required to decide whether or not the cognitive capacities that I am discussing here are necessary features of intelligence. This question is not immediately relevant because even if we decide that manipulability is not a necessary condition for some event to qualify as intelligent, we must still admit that paradigmatically intelligent behaviors often possess this feature. So, at the end of the day, even if we decide that our definition of intelligence makes room for intelligent acts that are *not* manipulable by the agent, we will still have to provide an account of those particularly intelligent acts that *are* thus manipulable. As such, an account of manipulability will be part of our theory of intelligence whether or not manipulability is deemed to be a necessary condition of intelligent action.

3.2.3 Transferability

In addition to flexibility and manipulability, transferability or generality is also frequently invoked as a distinguishing characteristic of intelligent behavior. We can think of transferability as the requirement that intelligent behaviors possess the potential for wide application. If instrumental learning occurs in one domain but cannot be transported to another, then we should wonder if such changes are really intelligent. For example, if I can add jelly beans but not match sticks or sheep, then maybe I'm not really adding.

As with manipulability, we should notice that even if transferability does not turn out to be a necessary feature of intelligent events, paradigmatically intelligent behaviors possess this feature. That is, paradigmatically intelligent behaviors are largely context independent. Take propositional thought as an example: I can believe, desire, or fear that it is raining. I could do this yesterday, today, and tomorrow. I can do it in Boston, in Hawaii, or in Berlin—in the morning or at night. I can compare rain with snow. I can remember the summer rain of my childhood, and I can predict how rain will affect my weekend plans. Crucially, the emphasis on transferability points to the fact that we want intelligence to play a general role in our cognitive economy. We insist that knowledge and skills are accessible to an agent in a large number of circumstances. It follows from this that the information upon which intelligent behaviors depend will be stored in a form that is abstract enough to be applied at different times and places. It follows that such information cannot be bound to particular stimuli.

We should also notice that transferability is intimately related to both flexibility and personal-level processing. Transferable behaviors must be flexible if they are to break free from a particular domain in order to be utilized in others. In fact, we can think of transferability as a kind of diachronic or horizontal flexibility. But also, transferability must be person or agent level because to be transferred to various independent domains, information or skills must be centrally accessible. This point is especially clear if we think of the mind as composed largely of various modular, informationally encapsulated systems. In such a mind, transferring information between independent domains requires a central process that will be responsible for the appropriate extraction and application of information. We are confronted with the fact that information that is *in* a system, but not available *to* a system (Karmiloff-Smith 1992, p. xiv; Clark and Karmiloff-Smith 1993), that is, information that is subpersonal but not agent accessible, is not information that can be used by intelligent processes.

3.3 *Imitation and the Three Sisters*

Imitation functions as an important mechanism accounting for how children acquire abilities and skills, but we should be careful to notice that success at a task by no means entails the presence of flexibility, manipulability, or transferability. That is, developing the capacity to *a* does not mean that one can *a* flexibly, that one can manipulate the way in which one *a*s, or that one can transfer the knowledge required to *a* into another independent domain. As such, if imitation can guarantee task success but not flexible, manipulable, or transferable behaviors, then we must conclude that imitation alone cannot account for intelligence.

This fact about imitation becomes especially salient, if we turn to Annette Karmiloff-Smith's model of representational redescription (RR) (Karmiloff-Smith 1986, 1990, 1992). According to this model, human cognitive development progresses in three basic stages. Movement through these developmental stages "involves multiple levels of redescription, leading to increasing accessibility and flexibility" (Clark and Karmiloff-Smith 1993, p. 496). That is, as representational states are redescribed at higher levels, they begin to express more and more features characteristic of higher-order intelligence.

For our purposes, it is especially important to take note of the nature of representation at the first level of redescription. The first level of representational redescription, the I-level or implicit level, is "procedural and must be run in its totality. It cannot be accessed or operated on" (Clark and Karmiloff-Smith 1993, p. 495–496). I-level procedures are context dependent, inflexible, informationally encapsulated, and not accessible to consciousness. They are procedures that are rigid, sequentially constrained, difficult to interrupt, individuate, change, and control (Karmiloff-Smith 1990). However, and this is vital for our purposes, I-level procedures support practical success. That is, behavioral mastery is achieved at the I-level, and in fact, "behavioral mastery is a prerequisite for subsequent representational change" (Karmiloff-Smith 1990, p. 60).

This means that at the I-level, a child is capable of successfully performing a task, but the child cannot reorganize, reorder, shuffle, manipulate, or access the procedures responsible for successful task performance. The performance hits its mark, but it is not flexible, manipulable, or transferable. As Karmiloff-Smith writes about linguistic development:

> Despite the limitation of the implicit representations symptomatic of phase 1, it is essential to recall that by the end of the first phase for a particular linguistic form, children have achieved communicative adequacy in their use of the particular linguistic form. (1986, p. 106)

As such, the presence of flexibility, manipulability, and transferability in human thought does not immediately follow from practical success. This has severe implications for imitation because it suggests that imitation, as a basic mechanism, can only account for a child's acquisition of first-order representations but not for later representational change. After all, we have no reason to posit that imitation, by facilitating the acquisition of task-specific capacities, provides children with anything beyond first-order, implicit, procedural states. The central point is that imitation can account for task success, but task success does not entail intelligence. So, though the kinds of practical behaviors acquired through imitation are impressive in breadth and complexity, they turn out to be fairly low-level cognitive achievements in terms of the spectrum of their intellectual characteristics. As such, we must conclude that though imitation can account for ability acquisition, it cannot account for the higher-order cognitive features that are part and parcel of intelligent behavior.

Of course, at this stage, it wouldn't hurt to ask what we need to add to behavioral success in order to get to intelligence. One proposal that seems plausible is that what is needed for intelligence is the capacity to "develop explicit representations which allow a system to become more manipulable and flexible" (Clark and Karmiloff-Smith 1993, p. 503). That is, "explicit representations provide a system with a kind of flexibility and generality not possible in any first order network" (Clark and Karmiloff-Smith 1993, p. 492). It isn't entirely clear why explicit representations get us this sort of payoff, but one possibility is that explicit representations, since they are represented outside of the subsystems in which they are run, can be entertained off-line in various independent settings. As such, with explicit representation, we get a dissociation from the immediate stimulus environment, which offers us the possibility of entertaining representations whether or not they are immediately relevant. It seems that with explicit representation, we become what Dan Dennett (1996) has termed "Popperian animals." That is, we become the kind of animals that can do trial and error in our heads; an animal that can let its hypothesis die in its stead. As Ruth Millikan writes, "The Popperian animal is capable of thinking hypothetically, of considering possibilities without yet fully believing or intending them. The Popperian animal discovers means by which to fulfill its purposes by trial and error with inner representations" (Millikan 2006, p. 188).

But we should notice that representation into explicit form is not a straightforward consequence of the behavioral mastery that is acquired through imitation. After all, there is nothing in the specifications of imitation that seems even remotely poised to guarantee that the results of imitative learning are represented explicitly. Therefore, it becomes impossible to hold, without further refinement, that the mechanisms of imitation will be able to account for the development of the explicit representations that underwrite the flexibility, manipulability, and transferability of human thoughts and behaviors.

4 Imitation and Skill Refinement: Making Our Way up the Cognitive Ladder

As we have seen, imitation can provide an account of the facility with which children pick up various practical and cultural competencies. We see that the imitative faculty is crucial in accounting for the easy transmission of highly nuanced human knowledge and skill, and in creating the circumstances for shared intentionality and cooperative action. Imitation goes a long way in explaining how children become proficient in relating to both objects and other people in an impressive variety of ways in an incredibly short period of time. Despite the impressiveness of this kind of learning, however, we must be careful not to overstate the work that imitation can do in our theory of cognition. Specifically, we must be careful not to confuse the social and behavioral mastery that imitation affords with the higher-order, full-fledged, florid, flexible, manipulable, transferable, recombinable, agent-directed intelligence present in fully mature, conceptual thought.

Though imitation alone cannot ground a theory of human cognition, in this section, I will elucidate how the means-centric orientation, which I have argued is central to imitation, can be employed in order to explain movement up the cognitive ladder. I propose that the means-centric orientation, which drives imitation in an intersubjective context, when inverted onto one's own actions, can provide us with a way to move from the first-order stage of implicit, procedural, practical success to the intermediate level of cognitive development. In particular, I claim that shifting the means-centric orientation from the intersubjective realm into an intrasubjective arena endows children with the capacity to move beyond ability acquisition and into a stage of skill refinement. And it is through skill refinement, as I explain below, that the first signs of intelligence begin to appear.

The sort of transition from the interpersonal to the intrapersonal that I am suggesting should not be altogether startling to those familiar with classic childhood development literature. In fact, this is a fairly straightforward application of Lev Vygotsky's conjecture that "[e]very function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (interpsychological) and inside the child (intrapsychological)" (1978, p. 57). Even if this claim turns out to be false as a general principle, we can see that it is quite apt in this particular context. By embracing the shift from the *interpersonal* means-centric orientation to the *intrapersonal* means-centric orientation, we find ourselves in a position to explain how it is that a child first begins to control, guide, attend to, and refine her own actions. By embracing this transition, we are in a position to explain how a child's own abilities and behaviors become a "problem space"[15] for her. And once we have done this, as I will argue below, we are in a position to explain the birth of the agentive features characteristic of cognition.

We can conceptualize the above transition in the following manner: the intersubjective means-centric orientation present in imitation highlights children's concern with reproducing the particular detailed manner or style of an observed intentional behavior. When imitating, we see that children are concerned with the strategies of an observed action, not merely insofar as they are instrumental for reaching some end but as objects of interest and concern themselves. Now, if we reapply this means-centric orientation intrapersonally, what results is a concern for and attention to the particular detailed manner or style in which *one executes one's own* actions and abilities. As such, a child's own abilities become a source of attention and curiosity. So, just as imitation makes the particular detailed means of an observed action salient, valuable, and interesting, the intrapersonal means-centric orientation makes the detailed means of *one's own* actions salient, valuable, and interesting. Crucially, at this stage, the previously transparent, instrumental means by which various ends were achieved are now poised to become ends in themselves. And this transition from means as ends in the world to means as ends in oneself, I claim, holds special explanatory power.

This is because when a child's own actions become ends in themselves, the particular way in which she performs a task becomes something for her to attend to, manipulate, and control. With this shift, she becomes able to invert her attention onto herself in order to take her own actions as objects to be transformed, improved, and perfected. As such, the means-centric orientation grounds a child's motivation to rearrange, reorganize, replace, refine, guide, and control the means by which she performs certain tasks. And this transition, I claim, provides us with a foundation upon which to explain the transition from first-order behavioral mastery to the limited flexibility, manipulability, and transferability that arises at the intermediate stage of cognitive development. It is precisely this transition, I claim, that paves the way for substantial cognitive change.

We should notice that as a result of the inversion of the means-centric orientation, children become engaged in what I call skill refinement. After all, this is exactly what skill refinement requires—that agents express a concern for their own actions and attempt to improve not only the probability that they'll reach some end but also the particular manner or style employed to reach that end. As such, we see that the means-centric orientation, applied to oneself, provides an explanation of why humans have a special interest in developing their own abilities. The inversion of the means-centric orientation onto one's own actions allows us to account for the peculiar human habit of expending huge amounts of energy on the practice and perfection of abilities long after they have reached the point of proficiency. But it also offers us a naturalistic, embodied explanation of the ontogeny of intelligence.

[15] This is Karmiloff-Smith's term (1990, p. 139).

4.1 *Skill Refinement and the Intermediate Stage of Cognitive Development*

At the intermediate stage of cognitive development, through recurrent cycles of redescription, representational states begin to take on novel properties. Karmiloff-Smith describes the intermediate stage of the RR model as composed of two transitions (Ei and Eii). At the Eii stage, a child first has conscious access to her own implicit procedures, and she begins to "gain some control over the organization of her internal representations" (Karmiloff-Smith 1990, p. 107). It is here, in a primitive and limited way, that flexibility, manipulability, and transferability characteristic of intelligent processes first make their appearance.[16]

Though I rely heavily on Karmiloff-Smith's model of representational redescription in order to support my own claims about skill refinement and cognitive development, my model differs from hers in an important way. Whereas Karmiloff-Smith claims that children at the intermediate stage of cognitive development are primarily concerned with their own internal representations, I claim that the object of concern for children at this stage of cognitive development is their own abilities and actions. On my account, it is not her internal representation that a child attends to and tries to control but the way, manner, or style in which she performs intentional actions.

As such, pace Karmiloff-Smith, I claim that at this middle stage of cognitive development, "a child turns her focus onto refining her abilities and not onto refining the representation of those abilities" (Fridland forthcoming). On my way of understanding this intermediate stage, the major shift from the implicit level to the intermediate stage of cognitive development is best described as a shift in concern from actions that are directed at the world to the way or manner in which one performs those actions. It is not, as Karmiloff-Smith suggests, a shift from actions directed at the world to one's internal representations of those actions.[17] On my account, the child at the intermediate level of redescription is involved in skill refinement.

We should also note that the choice between identifying a mental state as having a representation of an action or ability as its intentional object and a mental state having an action or ability itself as its intentional object is not simply a semantic one. This is because when we are concerned with intentional states, we are concerned with states that have both intensionality (with an s) and extensionality. That is, we are concerned with states that, in Fregean terms, are subject to a sense-reference distinction (Frege 1892). As such, we cannot simply conclude that since an action or ability is actually a kind of representation, then that in attending to that action or ability, the child is attending to it *as a representation.* And it is the question

[16] See Karmiloff-Smith (1986, 1990) for evidence of the systematic limitations on flexibility and transferability present at the intermediate level of redescription.

[17] See Fridland (forthcoming) for an argument diagnosing why Karmiloff-Smith makes this mistake.

of what the child is attending to, from the child's perspective, which is of central concern for us here. As such, this distinction that I make above is a crucial one for this theory.

Returning to my account, the intermediate stage of cognitive development is marked with a transition from a concern with means as ends located in the world to a concern with one's own means as ends. As a result of this transition, we can first see fixed, first-order, implicit, procedural action sequences break apart and become individuated and reidentifiable action elements that are capable of showing up in a variety of contexts. The procedural behaviors that once went unnoticed but served as perfectly good ways to achieve certain ends now become sources of attention and concern themselves. When these fixed, instrumental behaviors become ends in their own right, through a kind of practical trial and error, they are refined into individuated elements out of which a basic syntax of action can be composed.

4.2 The Labor of Skill Refinement Spawns the Three Sisters

In the following section, I provide an explanation of how it is that limited flexibility, manipulability, and transferability emerge out of skill refinement. I try to show how skill refinement is a process that grounds the compositionality, combination, and recombination of action elements, making room for the characteristic features of cognition that I have discussed above.

4.2.1 Trial and Error

At the intermediate stage of cognitive development, the child's objective becomes the improvement or refinement of the way in which she instantiates her abilities. These attempts to refine the way or manner in which she performs certain tasks require that the child interferes with the fixed action sequences that have up until that point been used for reaching her ends. In order to improve, the child must change the way in which she performs her actions. As such, skill refinement requires intervention for the sake of variation. Through the process of skill refinement, the child quite literally breaks up her procedural knowledge and introduces the seeds of flexibility into her actions as a result.

Implementing the kind of interference required for skill refinement is best construed, I claim, as a process of practical trial and error. The child, at this stage, begins experimenting with the way in which she instantiates her abilities. In order to figure out how to improve upon the way in which she performs some action, the child must play with different ways of producing the action. In order to do things better, she must figure out how to do things differently.

As we reflect on embodied expertise and skill refinement, we see that before acquiring the kind of control that is required for high-level skills, children must sacrifice basic proficiency. We see evidence of the primitive decomposition process that results from trial and error in the mistakes that children make in domains in which they have previously achieved behavioral mastery. Specifically, there is evidence that after attaining procedural success, children begin to exhibit marked errors (Karmiloff-Smith 1986). These sorts of mistakes offer clear evidence that an interference and reorganization of the implicit procedures responsible for first-order task success is taking place:

> This kind of trade-off between success and flexibility is easy to understand. To improve the way in which one performs some task requires shuffling, shifting, adjusting, and altering the way in which the task is instantiated. The once fixed but successful sequence is tweaked through trial and error and, as a result, the child makes various errors when instantiating it. (Fridland forthcoming)

In this way, we see that trial and error introduces flexibility into an action sequence, but at first, it does so at the cost of efficacy. In order to gain control over her own abilities, that is, in order to gain the capacity to flexibly manipulate her actions, a child must interfere with her automatic, fixed, implicit behaviors. She must apply effort and attention in order to perfect her actions, but this means overriding and thus sacrificing her reliable, first-order, procedural behaviors.

We should notice that because the child interferes with her actions through a process of effortful trial and error, we see the most basic shoots of manipulability arise in this context. That is, refining one's own abilities is a process that begins and ensues because of the child; it is the child that instigates, engages, and controls the process of ability refinement. And it is precisely this kind of effort and control that constitutes the property of being manipulable or under the control of the agent. So, in order to reorganize the means by which she achieves certain goals, the child must manipulate her actions. It is through a coarse kind of top-down control applied to her first-order behaviors that fixed actions sequences begin to break apart and acquire a degree of flexibility.

Importantly, in order for a child to treat her abilities as objects to be changed and manipulated, she must be able to take them as objects of interest. As such, we see that without the basic conditions that the means-centric orientation provides, the refinement of abilities would be impossible. This isn't to say that the means-centric orientation is the only driving force behind skill refinement. The social setting of the child can certainly be a motivation as well. The child may want to improve a certain ability because she sees her older brother doing it, her classmates, or a celebrity on TV. Still, it is the capacity to produce an inverted perspective onto one's own actions that will underpin the child's ability to practice and perfect the ways in which she performs particular tasks.

The takeaway point here is that as a result of the trial and error process required for skill refinement, a child manipulates her behavioral repertoire and introduces a degree of flexibility into her action patterns. As a result of this limited, crude kind of flexibility and manipulability, through recurrent cycles of repetition, a child creates the conditions for more and more fine-grained flexibility, manipulability, and transferability.

4.2.2 Individuation and Recombination

The process of practical trial and error breaks up fixed action patterns and allows behavioral procedures to relax in various limited ways. This kind of intervention allows for, at first, coarse-grained action elements to emerge out of whole behavioral sequences. That is, out of fixed, rigid, uninterruptable procedures, individuated action elements emerge. For example, a procedure goes from being one whole sequence to being composed of two parts: a beginning and an end. These parts, freed in this small way from their former procedural rigidity, take on the capacity to combine and recombine in limited ways.

As action elements attain a degree of freedom and independence, they also acquire the capacity to become the intentional objects of further trial and error, attention, effort, and control. As the boundaries of individuated action elements become more pronounced, the parts can then be manipulated further, which injects more flexibility and further individuation into the behavioral sequence. As such, the process of skill refinement produces more fine-grained elements that can be further combined and recombined in various contexts. Individuation and recombination break behavioral sequences into fine-grained action elements, which, through practical trial and error, can become subject to further individuation and recombination. Thus, individuation spawns freedom for recombination, which spawns further individuation, which spawns further recombinatorial freedom, and so on.

Happily, through the process of skill refinement, we notice the development of a basic syntax of action, which requires the features of flexibility, manipulability, and transferability. Like the concept "RAIN" must be able to show up in different thoughts, in different positions, and propositions, we see that skill refinement allows action elements to do the same. We see that skill refinement produces action elements that can play various roles in the constitution of various actions. So, for example, the kick before a cartwheel can show up as the kick before a handstand, in between a front walkover and an ariel, or at the end of full turn. The kick can take different positions in different actions, once it becomes an identifiable and reidentifiable element. Another way to put this point is that the individuated elements out of which skills are composed become transferable from one task to another. They become capable of playing a general role in the domain of skilled action.

From this discussion, we should conclude that skill refinement plays a central role in producing the distinguishing characteristics of intelligence. This is because skill refinement is responsible for the individuation of first-order behavioral sequences into combinable and recombinable parts. Importantly, we should notice that (1) the more fine-grained the individuated elements constituting a skill become, the more flexible, responsive, and adaptable the skill is, and (2) the more fine-grained the action elements constituting a skill become, the easier they are to manipulate and control. Finally, (3) as the sequences responsible for ability instantiation break down into more and more fine-grained, identifiable action elements, the easier it is for these elements to break free from any one particular sequence to be transferred to other tasks and behaviors. It should be clear, then, that at this intermediate stage of skill refinement, we enter into a realm where the features of intelligence can truly be said to apply to the behaviors of children. Through skill refinement, we are able to give a naturalized, embodied, developmental account of the flexibility, manipulability, and transferability of cognitive states and processes.

5 Conclusion

In this chapter, I attempt to connect imitation to the development of higher-order cognition by isolating and identifying the means-centric orientation as the motivation for imitation. Once this motivation is identified, I show how it can be used to account for skill refinement. I also hope to have convinced the reader that skill refinement offers us a naturalized strategy for accounting for some characteristic features of intelligent states and behaviors.

In the second section of this chapter, I argue that in order to develop an adequate account of human imitation, we must take seriously the means-centric orientation. The means-centric orientation, I claim, makes the means of intentional actions salient and interesting for not-merely-instrumental reasons. This orientation gives us an explanation of the human preoccupation with imitative learning in a way that an account that makes reference to social, cooperative reinforcement alone cannot.

In the third section of this chapter, I investigate three characteristic features of intelligence: flexibility, manipulability, and transferability. By relying on Karmiloff-Smith's theory of representational redescription, I argue that imitation alone, though impressive as a strategy by which to gain behavioral mastery, cannot provide us with an account of these three central features of intelligence.

In the final section of this chapter, I propose that by inverting the means-centric orientation onto oneself, one can move from the first level of procedural task success to the intermediate stage of cognitive development. I argue that this intermediate stage is one of skill refinement, where a child's goal is to practice and perfect the way or manner in which she instantiates her abilities. Through this process, the first signs of intelligence emerge. This is because as children work on their abilities, they begin to break apart their fixed action patterns into identifiable and reidentifiable action elements, which can then be combined and recombined in various ways and contexts. This process, I claim, is the process through which flexibility, manipulability, and transferability develop.

I hope that this brief overview has elucidated how skill refinement, underpinned by an inverted means-centric orientation, accounts for the emergence of flexibility, manipulability, and transferability by producing a basic syntax of action. Though more work needs to be done in order to get us to completely abstract, conceptual thought, I take it that this naturalized story of skill refinement and intelligence puts us on a productive path.

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