The Microgenetic Method: Time for Change?

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Change is an inevitable, but important aspect of our lives. Football teams travel up and down the leagues, governments come and go, we make the transition from nursery to school, school to college or a job and then from job to job. As change affects everyone and is so endemic, it is crucial that psychologists have an adaptable approach to measure it. Yet, paradoxically in attempting to identify how change occurs, much of psychology has focused on events before and after such transitions without considering the process itself. In this article we argue that it is now time that psychological methods of enquiry give us more than just a snapshot of the events surrounding change. The Microgenetic Method offers a clear view of change *as it is actually happening.*. We describe this approach, provide some examples of its use, and reflect upon how its techniques are once again coming to be used to address key psychological questions.

What is the microgenetic method?

The microgenetic approach examines change as it is occurring, thus attempting to identify and explain its underlying mechanisms. It involves taking repeated measurements from the same participants over the course of transition in the ability of interest. This contrasts with the usual, cross-sectional methodological approach, which provides a snapshot of competence at one or more time points. The

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cross-sectional approach is useful when these snapshots are taken for a number of people, so that the individual differences between these competences are examined, or when the 'snapshots' for people in different experimental or clinical groups are compared. Yet these cross-sectional approaches do not tell us about how change occurs, or what mechanisms underpin change. It may be of interest to know, for example, whether the change in a behaviour was sudden or gradual, or to identify whether the change was preceded by a particular behaviour, or accompanied by the person doing something in particular. The only way to specify the mechanisms of change is to examine closely the transition process. This is just what the microgenetic method involves. It provides information about the processes and mechanisms of change by following three critical principles:

1. Observations must span the period of change.
2. Density of observations must be high in comparison with the rate of the change.
3. Observations are analysed intensively to establish the process that gave rise to them.

By following these criteria detailed information about an individual's profile of performance over a period of transition is obtained. Among other elements it allows sudden jumps, regressions and periods of equilibrium to be identified. These elements of change provide an indication of how a person's knowledge or ability progresses from one level to another, often more sophisticated, level. The microgenetic approach is adaptable and so allows change to be examined in a number of different domains. To date it has been used to examine development in domains including theory of mind and inhibitory control (Flynn, O'Malley & Wood, 2004),

memory (Schagmüller & Schneider, 2002), locomotion (Adolph, 1997), attentional strategies (Miller & Aloise-Young, 1996), understanding of science (Pine & Messer, 2000, Pine et al., 2004) and arithmetic (Siegler & Svetina, 2002).

Importantly, the microgenetic approach provides an illustration of an individual's progression through the whole period of change, highlighting and emphasising elements that cannot be captured by traditional methods. For example, the following five dimensions can all be examined (Siegler, in press):

- **The path of change**: Is the change qualitative or quantitative?
- **The rate of change**: Is the change sudden or slow?
- **The breadth of change**: Is the change domain-specific or generalisable across domains?
- **The variability of change:** How variable is a person's behaviour across similar tasks within a domain? Can similar patterns of change be seen across individuals?
- **The source of change**: What do the changes in behaviour, such as strategy use, suggest about the source of change?

Is this a new and easy way to study change?

The term 'microgenesis' was first used some 50 years ago by Werner (1956) to describe a method of repeating presentations to the same participants to measure discrimination in auditory perception. Since then the approach has been used across Europe and the USA (see Siegler (in press) for an up-to-date review). It is fair to suggest that the approach has come in and out of fashion over the past half century, Yet, the number of microgenetic studies has increased rapidly over the last twenty years, and this trend looks set to continue.

It is easy to explain psychology's reluctance to take this approach on board as the main methodological technique. Microgenetic studies are not without their methodological difficulties. Repeated testing of participants, especially children, can produce boredom and reduce motivation, and this may lead to loss of participants. At the same time, repeated presentation of stimuli can produce practice effects, which mean that a control group must be included in studies to establish how much of the change is due to the experimental procedure and how much is due to development. Microgenetic studies are also expensive in terms of time and labour. Finally, testing participants on multiple tests over a number of sessions produces a great deal of data, especially when the analysis is undertaken at a trial-by-trial level. The very intensity of the approach, although rich and informative, can make it difficult to reduce the data down to a simple set of results and conclusions. It is perhaps not surprising that most researchers opt for the quick fix of the cross-sectional study.

So, why use the microgenetic method?

However, the challenges in using the technique have not dampened down the increasing popularity of microgenetic research. Researchers have had to be ingenious in designing studies to reduce such baises, seeking ways to increase participants' motivation, and using control groups to take into account practice effects. The microgenetic approach has a number of advantages for all those interested in studying how change occurs, with its focus on rich, fine-grained description of the issue under investigation. By examining individual participants' behaviour over time, this reduces within- [OR DO YOU MEAN BETWEEN- KAREN?]participant variability, but also provides an opportunity to examine the differences, and the underlying sources of differences, between individuals For example, the microgenetic method provides an opportunity to identify different groups, which may require different treatment or

intervention styles. This can yield answers to questions that cannot be answered by other approaches. Most excitingly for developmental psychologists is the fact that microgenetic studies *'reveal not just what children know but how they get there'* (Granott & Parziale, 2002, p.12). The same may apply to adults acquiring new skills. Importantly, sometimes the results of microgenetic research lie in contrast to the findings from cross-sectional research. Two examples of such discrepancies are presented here to illustrate these dimensions of the technique.

Example 1: Examining the success of interventions

Pine and Messer (2000) examined the effect of explaining another's actions on children's understanding of the concept of balance. The study employed a traditional pre-test, intervention, post-test paradigm. In the intervention phase children either observed the experimenter solving balance problems that the child could not solve *(Observe Only);* or they observed and tried to explain the experimenter solving the problems (*Observe and Explain*). This study showed that children in the latter condition (*Observe and Explain*) were more likely to improve at post-test than children in the former condition (*Observe Only*). So, by examining pre-to post-test change it was shown that explaining another person's actions can bring about cognitive change (Pine & Messer, 2000; see also Siegler 1995). However, within any study it is rare for every participant to show improvement, and statistical analysis simply confirmed that more participants in one group than the other improved. Nonetheless, in the condition that brought about most improvement there were still 30% of the group who failed to improve. And in the condition that did not produce as much improvement, still 50% of the children did improve So the researchers went on to conduct some microgenetic analyses of the children at pre-test to see if anything else, apart from the experimental conditions, might have predicted improvement

(Pine, Lufkin & Messer, 2004). By looking very closely at the explanations about balance that children gave as they talked during the pre-test trials, it was found that the children's speech and also their hand gestures could be reliably coded into a set of discreet and reliable categories. After carefully scrutinising the children's speech and gestures on all the pre-test trials children were identified who showed gesture-speech mismatches at pre-test. These children (about one third of the sample), talked about one element of the task whilst producing a hand gesture that conveyed a different element. The data were then reanalysed including this new microgenetic analysis and the match between gesture and speech was found to explain a lot more about the children who did improve (even when in the less optimal *Observe Only* condition) and those who did not (even if they experienced the more 'effective' *Observe and Explain* condition).

Children who were in the less helpful condition but still improved were more likely to have shown gesture-speech mismatches at pre-test. And, of the children in the more effective condition who failed to improve, at pre-test three times as many did not produce mismatches as did. This study demonstrates how microgenetic analysis, in this case close examination of gestures produced during a set of trials, can tell us more about when and why interventions sometimes produce change but in some cases do not. Failing to take account of the children's gestures in this study would have meant that an important source of information was overlooked.

Example 2: The development of organizational skills

Microgenetic studies sometimes question the conclusions of cross-sectional studies. Schagmüller and Schneider (2002) investigated the rate of change of organizational skills on a sort-recall task in children aged 8 to 12 years. They presented a set of tests every week for nine testing sessions over an 11-week period.

In each session children were presented with a set of 20 picture cards that each contained a picture of an item from a set of categories, e.g., animals, vehicles, fruits. During each session children were told to study the cards and to do whatever they wanted with them to help remember them later. They were given three minutes to memorise the cards. After this the cards were removed, and the children played several word and number games for three minutes. Children were then asked to remember as many of the picture cards as they could. The children's recall was recorded, along with their sorting during learning and their clustering during recall.

Before this study the classic assumption for the development of organizational strategies was that they gradually increased with age. Yet, Schagmüller and Schneider's data showed that this was not the case. Children progressed rapidly from non-strategic to strategic performance during the 11-week testing period. They '"jumped" from random behavior to nearly perfect sorting scores" (Schagmüller & Schneider, 2002, page 313). It is only by taking repeated measures from the same people over the period of change, as dictated by the microgenetic method, that the actual rate of development could be established. Less intensive methodologies would not have been able to illustrate the actual rate of development.

New areas of investigation

Not only is the microgenetic method being informative about how change occurs, it is also an adaptable approach. It can be used to examine spontaneous or facilitated change in one individual or, indeed, in multiple participants. Measurements can be taken over a single testing session or multiple sessions. Therefore the analysis can examine session-by-session or even trial-by-trial change. Furthermore, change can be examined within individuals, or pairs of of individuals working together with relative amounts of expertise.

,. Most microgenetic research has examined cognitive development, looking at the acquisition of mathematical or scientific concepts. However, the technique can be used to good effect within a variety of applied settings. One important aspect of looking at cognitive development using the microgenetic method is the potential for introduction of these findings into the classroom. For example, we know the stages and processes through which children make the transition from no understanding to full understanding of scientific concepts. The crucial next step for such findings is for this knowledge to be implemented into the classroom, taking account of the elements that intervene in the learning process. Evidence from microgenetic studies can help predict when teaching and interventions will be beneficial, and this promises to be a useful tool for implementation into classroom practice.

As well as interesting opportunities within an educational setting the microgenetic method has much more to offer the applied community. The application of the microgenetic method within the clinical setting has been relatively limited (Bray, Fletcher & Turner, 1997; Fletcher, Huffman, Bray & Grupe, 1998). Such a shortfall in clinical-based microgenetic research seems noteworthy, as change is frequently the main goal of mental health interventions. The microgenetic method can offer an approach to examine positive change, i.e., rates of improvements through different treatments or interventions, and detrimental changes, i.e., rates and pathways of symptomatic detriments in disorders. Furthermore it may help to explain why critical life events sometimes have a lasting impact (such as depression or post-traumatic stress disorder) and yet at other times have no apparent impact. Questions such as these might be answerable when more is known about micro- as well as macro -development (Lewis, 2003).

The microgenetic method also provides an important diagnostic tool for clinicians. In developmental psychological research the approach often reveals competencies at an earlier age than cross-sectional studies. In its intensity of repeated observations, participants have more opportunities to demonstrate different types of behaviour. So, by taking more measurements researchers can observe behaviours that may be less frequent, but still within a patient's repertoire. This approach has the advantage, therefore, of revealing the full range of behaviours that an individual can produce under experimental conditions. Therefore we are able to witness successes, even when these successes are less frequent than failures.

Conclusions

In this article we have put forward the case that microgenetic methods have much to offer to the understanding of the cornerstone of psychological research, change. This is brought in to sharp relief in developmental psychology, particularly as childhood is a period when the pace of change is often dramatic. We contend that to take this construct seriously developmental research needs to go beyond traditional methods of examining cross-sectional or even longitudinal data. Such approaches can only tell us when change occurs and identify a subset of the factors that bring about change. In order fully to understand what the mechanisms of change are, the trajectory of change (which is not always smooth), its rate and breadth, a greater diversity of microgenetic methods are required. By examining change *as it occurs* this method can yield more precise descriptions than would otherwise be possible. This type of rich and detailed data is necessary for constructing formal models of cognitive development. Furthermore, a significant contribution to pedagogic and clinical

knowledge can be made since this method helps us understand how instructional and therapeutic procedures exercise their beneficial effects.

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