Developmental stages, Piagetian stages in particular: A critical review☆

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ABSTRACT

Developmental stages in general and Piaget's stages in particular have given rise to considerable controversy. Much of this controversy revolves around the responses that have been given to the following five central questions: (1) Do developmental stages exist? (2) If they exist, where are they? (3) What features define a developmental sequence as a sequence of developmental stages? (4) What psychological processes underlie developmental change? (5) Should we abandon the concept of developmental stages? The main goal of this paper is to present a critical review of such responses, while arguing for a strong conception of development and a "non-received" view of Piaget's theory. After an introduction section, we elaborate on each of the five questions. Finally, we present several reasons why this paper often appeals to Piaget's theory, and why his theory has been greatly misunderstood.

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Developmental stages on the one hand and Piaget's cognitive stages on the other have been the center of considerable empirical research and theoretical controversy (e.g., Bart, 2004; Beilin, 1992a; Bickhard, 1978; Campbell & Bickhard, 1986; Collins, 1982; Dawson-Tunik, Fischer, & Stein, 2004; Feldman, 2004; Fields, 2013; Flavell, 1970, 1982; Fodor, 1983; Gopnik, 2012; Karmiloff-Smith, 1992; Kesselring & Müller, 2011; Kohlberg, 1984; Levin, 1986; Modgil & Modgil, 1982, 1986; Müller, Carpendale, & Smith, 2009a; Pinard & Laurendeau, 1969; Thelen, Schöner, Scheier, & Smith, 2001; Youniss, 1995).

This controversy revolves around answers to the following questions: (1) Do developmental stages exist? (2) If they exist, where are they or where we should look first for them? (3) What features define a developmental sequence as a sequence of developmental stages? (4) What psychological factors and processes underlie developmental change, be it qualitative, discontinuous and stage-like, quantitative, continuous and gradual, or even continuous and discontinuous? (5) Should we abandon the concept of developmental stages?

Drawing on previous literature, this paper offers an answer to, and reflects on, each of these questions, while arguing for a strong

conception of development and a "non-received" view of Piaget's (1983a) theory. Despite the vast literature providing responses to such questions, there is no paper that addresses the main responses to each one in the way this paper does. As will be seen, the majority of the answers to those questions heavily rely on a weak conception of development and a "received" view of Piaget's theory.

In a *strong* conception of development, developmental stages are characterized by the following criteria: (a) *Hierarchy*: stages appear in an invariant, hierarchical order; (b) *integration*: a given stage integrates, albeit overcomes or transcends its predecessor; (c) *consolidation*: before all features that define a certain stage are present, there is a phase of preparation wherein the stage still presents some features of the previous one; (d) *structuration*: a stage is organized by what Piaget (1983a) called *structures d' ensemble* or overarching structures, that is, a way of thinking/ knowing which has some formal and logical properties and is applied to different contents; and (e) *equilibration*: if an individual is capable of performing according to the criteria of a given stage, then s/he is at a certain degree of (unstable) equilibrium, and is not cognitively "perturbed" when s/he has to solve problems whose solution does not require competencies that go beyond the competences linked to the stage at hand. For example, the Piagetian formal operational stage represents a higher level of equilibrium than its concrete operational counterpart because, among other things, formal thinking includes two types of reversibility (negation and reciprocity) and concrete thinking only one (negation or reciprocity, but not both). (See Inhelder & Piaget, 1958; Piaget, 1960). In

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a *strong* conception of development, developmental stages are "hard structural" (see Kohlberg & Ryncarz, 1990, pp. 204–206) as opposed to "soft" stages, such as Loevinger's (1976) stages of ego development. With hard structural stages, developmental changes (1) are necessary rather than optional tracks of development; (2) embody operative reasoning which represents interiorized and reversible forms of action, such as Piaget's (1983a) mental operations, or Kohlberg's (1984) justice operations; (3) distinguish the content from the form or structure of thought; (4) can be formalized within a rational, normative model (Piaget, 1967); and (5) appeal to an epistemic, or rational, general subject as opposed to a psychological, individual subject (Inhelder & De Caprona, 1997).

As for the "received" view of Piaget's theory, we think that, among other things, this view wrongly assumes that: (a) it is people, more than their performances and cognitive processes in a given situation or task, who can be characterized in terms of developmental stages; (b) age is a criterion rather than an indicator of development; (c) the chronology of acquisitions is more important than the sequence of transformations; (d) he was more interested in true than in necessary knowledge; (e) Piaget's overarching structures (e.g., the groupings) are functional entities that are responsible for the emergence of the typical performances linked to a given stage, not formal, logicomathematical properties of such performances and cognitive processes; (f) the subject's construction of knowledge is a solitary enterprise; (g) there is only a single developmental pathway; (h) when solving Piaget's tasks, subjects follow rules, mental images, or a preexisting mental logic rather than acting upon objects and coordinating those actions into relational totalities; and (i) only structure and form, not content and meaning, play a central role in operational understanding and development (see Beilin, 1992a,b; Carpendale, 2000; Chapman, 1988, 1992; Inhelder & De Caprona, 1997; Kesselring, 2009; Kitchener, 2009; Lourenço & Machado, 1996; Smith, 1993, 2009).

Much of the controversy around the main responses to each of those questions has had to do with *neo-Piagetian theories*, such as Pascual-Leone's (1970), Case's (1992), Halford's (1993), Fischer's (1980), and Demetriou's (1998) approaches (see, for a description of these theories, Knight & Sutton, 2004; Mora, 2007; Shulman, Restaino-Baumann, & Butler, 1985). Neo-Piagetian theorists integrate ideas from Piaget's theory with concepts and concerns coming mainly from: (a) information-processing approaches, such as the concept of working memory (e.g., Klahr, 1992); (b) differential psychology, such as the problem of intraindividual and interindividual differences in cognitive development (e.g., Sternberg, 2002); and (c) the neurosciences, specifically the role of the brain in the emergence of developmental change (e.g., Burman, 2013; Carey & Gelman, 1991; Diamond, 2006).

The main goal of neo-Piagetian theories is to preserve the strengths of Piaget's theory as the neo-Piagetians see them, while eliminating its shortcomings. Thus, such theories: (a) maintain certain features of Piaget's theory, for example, that development proceeds through a process of differentiation and integration (e.g., Case, 1985; Fischer, 1980); (b) elaborate more deeply than Piaget (see Case, 1985) on other features of his theory, for instance, on Piaget's (1981) idea that affectivity energizes the subject's performances in every situation; and (c) modify Piaget's theory in many respects (see Fischer, 1980).

As is known, for a long period of time, Piaget (1967) appealed to logicomathematical notions, such as the groupings and the 16 binary operations of propositional logic, to describe the formal properties of the subject's cognitive processes and performances on his many tasks. According to neo-Piagetian theorists, such performances should not be described in such terms. Fischer's (1980) *skill theory*, for instance, describes those performances in terms of increasing integration of skills. For example, the preadolescent's

ability to coordinate two systems defining a simple abstraction (e.g., to understand that the arithmetic operations of addition and multiplication are the same thing because they both lead to a larger number) involves less integration of skills than the typical adolescent's ability to understand that such operations are similar because they both combine numbers leading to a larger number, but in a different way. In the operation of addition, numbers are combined through simple units (e.g., $2 + 2 + 2 = 6$), whereas in multiplication numbers are combined through groups of numbers (e.g., $2 \times 3 = 6$) (Fischer, Hand, & Russell, 1984, p. 49).

Differently, for Pascual-Leone (1970, 2000), such performances can be described in terms of quantifiable, continuous changes in a person's mental capacity, working memory or mental units. For example, to be capable of understanding the proportionality concept one must be able to keep in mind five mental units, such as the two pairs of numbers to be compared (e.g., 2/5 and 3/7) and their relation. On the contrary, one only needs to keep in mind two mental units to understand that a given number is larger than another.

In this respect, it is worth mentioning that, at the end of his career, Piaget's thinking was more oriented toward a *logic of meaning* (Piaget & Garcia, 1983) than a propositional logic (Piaget, 1967). In propositional logic, propositions are true or false, whereas in a logic of meaning propositions can be true, false, but also signifying (e.g., "If I'm a man, I'm mortal; I'm a man. Therefore, I'm mortal"), or nonsignifying (e.g., "If I'm mortal, I'm a man; I'm mortal. Therefore, I'm a man"). Note that all men are necessarily mortal, whereas not all mortals are necessarily men.

Piaget changed his theory regarding other issues of concern to the neo-Piagetians. For example, Piaget's (1972) idea that formal operations may not be applied except in domains of one's interest and expertise is an indication that his earlier stand — "I have no interest whatsoever in the individual. I am very interested in general mechanisms, intelligence and cognitive functions, but what makes one individual different from another seems to me far less instructive" (Piaget, 1971a, p. 211) — was relaxed as Piaget got older. Enough alteration took place during Piaget's late period that some developmentalists have been led to speak about Piaget's "new theory" (Beilin, 1992b). Unfortunately, Piaget's new theory seems to have escaped the notice of several developmentalists (e.g., Gelman & Baillargeon, 1983; Siegal, 1997).

Piaget's idea that individuals can be formal only in certain domains also shows that his *epistemic*, rational and nomothetic subject is not so opposed to a *psychological*, idiosyncratic subject as some of his critics have claimed (e.g., Murray, 1983). Moreover, even those who are convinced that Piaget conceived subjects in terms of their general, nomothetic, rather than individual, idiosyncratic characteristics, have made it clear that Piaget's emphasis on the epistemic rather than the psychological subject has led to "important misunderstandings and misses the deep and enduring meaning of Piaget's approach" (Inhelder & De Caprona, 1997, p. 4). Although Piaget (1950a) was more interested in the emergence of new forms of knowing than in individuals' development, he made careful, detailed naturalistic observations of real, not epistemic, children (e.g., Piaget, 1951).

Developmental stages, Piaget's stages in particular, have been also criticized for not explaining why development from one stage to the next occurs, and for overlooking or even ignoring individual differences in cognitive development. For example, according to neo-Piagetian theorists, developmental stages such as Piaget's do not account for the finding that some individuals move from stage to stage faster than other individuals, and that "… a particular situation may facilitate one subject's ability to solve a problem, whereas it may hinder another's" (Larivée, Normandeau, & Parent, 2000, p. 828).

We will return to this criticism of Piaget's theory. Here, it should be said that all of these criticisms take for granted the "received" view of Piaget's theory (see above). Note, for example, how point (i) of this view (i.e., only structure and form, not content and meaning, play a central role in operational understanding) is at odds with Piaget's (1972) idea that individuals can operate formally in certain contents, but not in other ones, and also with his reorientation toward a logic of meaning, a kind of logic which takes into account the role of meaning, and not just syntactic form, in thinking.

Consider a second example. Décalage—uneven performance among and even within domains—has been found (e.g. Bond, 2010) and used to refute the concept of developmental stages. But such findings rule out stages only if one accepts the received view of Piaget's theory.

As cogently noted by Chapman (1988), "[b]ecause the operations characterizing different content areas may present difficulties with respect to their organization, they are not expected to develop in synchrony" (p. 168). Chapman's remark could be substantiated, for example, by Piaget's idea that individuals can be formal in certain areas, but not in other ones. See also, for instance, the *Moral judgment of the child* (Piaget, 1932), where the same children—identifiable by code names and ages—are sometimes classified at different stages and phases on different problems. We return now to a critical examination of the main answers to each of our five questions.

1. Do developmental stages exist?

Although the response to this question is highly controversial in developmental psychology (see Alexander & Langer, 1990; Bart, 2004; Campbell & Bickhard, 1986; Collins, 1982; Dawson-Tunik et al., 2004; Feldman, 2004; Goswami, 2001; Inhelder & De Caprona, 1997; Karmiloff-Smith, 1992, 1993; Müller et al., 2009a; Smith, 1993; Youniss, 1995), we argue, in this section, for the existence of developmental stages as useful heuristics to chart developmental change over time.

Developmental stages lie at the heart of well-known developmental theories, such as Piaget's (1983a) theory of cognitive development, Kohlberg's (1984) theory of moral development, Erikson's (1959) theory of psychosocial development, Commons' (2008) model of hierarchical complexity, and so forth. Developmental stages are also accepted by several neo-Piagetian theorists (e.g. Case, 1985), and have been applied to other domains such as faith (Fowler (1981), progress in art (Gablik, 1977), esthetic experience (Parsons, 1987), education (Egan, 1997), healthcare markets and business (Umezawa, 2012), and so forth.

The fact that diverse developmental theories rely on developmental stages in different fields lends support to the idea that developmental stages exist, even though the concept is used with varying meanings. Suffice it to say that whereas the concept of executive control functions or structures — structures that enable the person to represent a problem situation, specify the objectives of problem solving, and conceive of the strategy needed to attain the objectives — lies at the heart of Case's (1985, 1992) developmental stages (sensorimotor, interrelational, dimensional, vectorial), such executive control functions have no place, for example, in Piaget's (1983a) and Kohlberg's (1984) theories. Actually, Piaget's cognitive stages and Kohlberg's moral stages represent a discontinuous change in one's intelligence—or thinking about justice, respectively—to differentiate and integrate varying dimensions and perspectives.

In addition, uneven levels of performance or décalage between and even within domains have been found and accepted by Piaget's theory (Piaget & Szeminska, 1980, p. 193), neo-Piagetian approaches (Larivée et al., 2000, p. 828), non-Piagetian views (e.g., Thelen & Smith, 1994), and post-Piagetian (e.g., Gopnik, 1996), if not anti-Piagetian, theories (e.g., Perner & Astington, 1992). Décalage has been also found in Kohlberg's (1984) theory of moral development. However, while décalage does not contradict Piaget's theory, it is inconsistent with Kohlberg's (1984) thesis that his moral theory, unlike Piaget's approach, completely separates moral content from moral structure. Note that this thesis of Kohlberg's theory has proven false (e.g., Carpendale & Krebs, 1995).

A second case could be made for developmental stages. Imagine an experiment designed to see how participants of different ages would respond to the critical question of a proportionality task: "In this bag, A, there are 2 white pearls and 3 black ones, and in that bag, B, there are 3 white pearls and 4 black ones. Is it more likely at a first trial to take out a white pearl from A, B, or is it equally likely to take out that pearl either from A or B, and why?" (Piaget & Inhelder, 1976). Without the concept of developmental stages, we would be deprived of useful heuristics for charting the developmental trajectory of those participants' responses and justifications to that critical question, and also to other related questions.

One might object that, for that purpose, one could appeal, not to developmental stages, but to the existence of developmental levels, periods, phases, cycles, seasons, layers, tiers, mental units, and so forth (see Levinson, 1986). As mentioned, Pascual-Leone (1988) uses the concept of mental units for characterizing the degree of logical complexity in participants' answers and justifications to the critical question in that proportionality task. However, to say, as Pascual-Leone (1988) does, that the correct answer to that question involves five mental units is tantamount to Piaget's idea that this answer involves the coordination of three comparisons. That is, when one first divides 2 favorable cases (white pearls) by 5 possible cases (i.e., 2 white pearls + 3 black ones) — one comparison — and 3 favorable cases by 7 possible cases (i.e., 3 white pearls + 4 black ones) — the other comparison — and then compares these two comparisons – the third — one gets a larger ratio in 3/7 than 2/5. In addition, taking five mental units into account does not guarantee a correct answer to the question mentioned above. First comparing two pairs of numbers (e.g., 2/5 and 3/7), which for Pascual-Leone involves 4 mental units, and then comparing their relation (i.e., the fifth mental unit) may lead a subject to say that a white pearl is equally likely to be taken out on the first trial from 2/5 and 3/7 because in both pairs there is one more black pearl. This answer involves 5 mental units, yet it is incorrect because it is more likely on the first trial to take out a white pearl from 3/7 than 2/5.

One might appeal to developmental levels instead of developmental stages to chart developmental change. Turiel's (1983) social domains approach, Fischer's (1980) theory of hierarchical skills, and Karmiloff-Smith's (1992) model of representational re-descriptions are only three examples. Turiel's (1983, p. 103), for instance, speaks about seven major changes or levels, not stages, in social-conventional concepts, and Fischer (1980) has proposed a hierarchy of thirteen developmental levels.

It is worth mentioned that Piaget also appealed to developmental levels in some of his last books, such as *Toward a logic of meaning*. (Piaget & Garcia, 1991). Unfortunately, Piaget's (1960) endeavors to clearly characterize developmental stages had no counterpart where developmental levels are concerned. In any event, Piaget never abandoned stages (see Feldman, 2004). But this does not imply that stages are at the center of his theory. We do not think so. As an epistemologist, Piaget was most concerned with the emergence of new forms of knowing (Piaget, 1950a), and with how they become necessary once constructed (Piaget, 1978, p. 5). We also think that it is incumbent upon those who appeal to different concepts (e.g., stages, levels, phases, periods, cycles, mental units, seasons, layers, and so forth) to chart developmental change to offer us a clear meaning of whatever concept they use for that

purpose.

But if one may wonder whether developmental stages exist, one may also ask whether developmental periods, levels, phases, cycles, seasons, layers, and so forth exist. It remains to be known to what extent these other concepts are better and clearer than the concept of stages as heuristic devices for charting, not explaining, developmental change. It might even be said that all those concepts are used in an interchangeable way (see Levinson, 1986).

A telling example can be found in Karmiloff-Smith's (1992) book *Beyond modularity: A developmental perspective on cognitive science*. She says that her model of representational re-descriptions (i.e., development is a process where initial, simple representations become more complex as they are successively re-described over time) is a "*phase* model, as opposed to a *stage* model", and that her "…model argues for at least four levels at which knowledge is represented and re-represented" (pp. 18–20; italics in original). In the end, is Karmiloff-Smith's approach a phase model, a stage model or a level model? We cannot know because Karmiloff-Smith remains silent about the distinctions among phases, stages, and levels.

Developmental phases, levels, periods, seasons, and stages cannot be used in an interchangeable way without problems. It makes sense to speak about moon's four phases, but it would be surprising to talk about moon's four stages. One may say that onions have several layers, but not several stages. There are four seasons, not four stages, in every year. In addition, we know of several deep elaborations on the meaning of the stage concept (e.g., Kohlberg, 1984; Piaget, 1960), but not on the meaning of the other concepts that are used for identifying and characterizing developmental trajectories. It is incumbent upon those who appeal to different concepts to chart developmental change to offer us a clear meaning of the concept they use for that purpose.

Another objection might be to say that to conceive developmental stages as conceptual tools to characterize the logical or social-cognitive complexity involved in a given subject's way of thinking amounts to arguing for the existence of stages with basis on their usefulness. However, one may counter that the more useful a concept is for identifying and characterizing developmental change, the more it makes sense to argue for its existence.

One could say of developmental stages what the French philosopher Voltaire (1768) once stated about a universe without God: "*Si Dieu n'existait pas, il faudrait l' inventer*" [If God did not exist, it would be necessary to invent him] (p. 403). If developmental stages did not exist in the field of developmental psychology, it seems that it would be necessary to invent them. Although there are other ways to theorize about development (Alexander & Langer, 1990) and to chart developmental change (Fischer, 1980), it is not a coincidence that developmental stages are posited by many important developmental theories. Nowhere have we seen a better and clearer concept than the concept of developmental stages to identify and characterize a developmental trajectory in varying domains. Remove indicators of developmental change, developmental stages in particular, and you are no longer talking about a central feature in many well-known developmental theories.

Of course, it is possible to be developmental without positing stages. However, we think that the less we posit stages, the more we are likely to adopt a weak conception of development (see above).

2. Where are developmental stages?

If developmental stages exist, the next question is "Where are they?" Answers to this question have also given rise to considerable debate. We think that much of this debate is due to: (a) neo-Piagetian theories (e.g., Fischer, 1980; Pascual-Leone & Johnson, 2013; (b) the advent of neuroscienfces (e.g., Damasio, 1999; Gazzaniga, 2005; Happé & Frith, 2014), developmental cognitive neuroscience in particular (e.g., Johnson & Haan, 2010; Zelazo, Chandler, & Chrone, 2010); and (c) the received view of Piaget's theory (Chapman, 1988, 1992).

For instance, the neo-Piagetian theorist Pascual-Leone (1970, 2000; Pascual-Leone & Johnson, 2013) has proposed that a quantifiable mental capacity, endogenous and subject to maturation, exists in the organism and increases quantitatively with every developmental stage. Accordingly, for this neo-Piagetian author, stages cannot be constructs in the theorists' mind, because they are organismic constructs that pertain to brain processing.

A similar position is embraced by well-known neuroscientists (e.g., Churchland, 1991, 2011; Damasio, 1999; Gazzaniga, 2005). For example, according to Churchland's (2011) *eliminative materialism*, there are no mental states, such as the theorist's beliefs and thoughts; there are only brain states or neural states. If there are developmental stages, they must be aspects of the brain.

Although there have been many versions of evolutionary psychology since Darwin (1962), neural determinism is emphasized in contemporary evolutionary psychology (e.g., Cosmides & Tooby, 1992; Gazzaniga, 2005; Haidt, 2001). It is certainly important to understand the neural roots of developmental stages and, hence, to investigate the neural activity occurring in the brain; for instance, in the prefrontal cortex, when one thinks in concrete or formal terms (Gazzaniga, 2005). However, such neural activity should not be considered as a necessary and sufficient condition of concrete operational or formal operational thinking.

Given the long, complex process that leads from genes, molecules and brains to human organisms, to partly understand where stages are we have to go beyond the brain, and look at the person's everyday social interactions, actions and coordination of actions (Carpendale, Sokol, & Müller, 2010), or at "language-games", cultural contexts and forms of life (Wittgenstein, 1958). In addition, if it makes good sense to say that a person thinks in a formal or concrete way, it is misleading and even nonsensical to say — as some neuroscientists do (e.g., Gazzaniga, 2005; Greene, 2007) — that his/her brain is concrete operational or formal operational in cognitive terms, or moral/immoral in moral terms. As cogently argued by and Bennett and Hacker (2003):

> Psychological predicates are predicates that apply essentially to the whole living animal, not to its parts. It is not the eye (let alone the brain) that sees, but we see with our eyes (and we do not see with our brains), although without a brain functioning normally in respect of the visual system, we would not see (pp. 72–73).

Contrary to this neural determinism, we think that if one wants to answer the question, "Where are developmental stages?", one should look first at developmental theorists who, "as a whole" — not as disembodied and "decontextualized" brains or minds — conceptualize, *a priori*, developmental stages in diverse domains as useful heuristics to characterize, in descriptive and formal terms, developmental change over time. Therefore, our answer is that developmental stages are in the developmental theorist's whole organism as a useful construct to chart developmental change. It is that theorist who, as a whole person, uses developmental stages as conceptual tools to identify and characterize developmental change in individuals' thinking about various domains, the cognitive, social, emotional, and moral domains, for example.

In short, developmental stages do not exist as reified, explanatory entities in the external world, or within disembodied and decontextualized minds or brains. As constructs posited by different developmentalists, stages cannot exist as reified entities

in the external world. And because when we think we think "as a whole," developmental stages cannot exist merely in our brains or minds.

Conceiving developmental stages as descriptive, formal tools allows developmentalists to see to what extent a subject's performance in a given task has certain descriptive and formal properties of a given developmental stage or lacks them. For example, to say that Piaget's concrete operational stage is dominated by children's focus on transformations rather than configurations is a descriptive characteristic of a concrete operational performance. To say that the typical performances linked to that stage can be formalized in terms of a Piagetian grouping attributes to such performances certain formal, logicomathematical properties.

The controversy about the location of developmental stages has much to do with the received view of Piaget's theory. Contrary claims (e.g., Siegal, 1997) notwithstanding, according to a non-received view, it is children's cognitive processes — neither children nor their behavior per se — that can be described and formalized in terms of the properties defining a given developmental stage.

Piaget did contribute, to an extent, to the idea that his stages are explanatory factors within the subject's mind, not conceptual devices put forward by developmentalists to characterize individuals' cognitive processes. On one occasion, Piaget (1941) referred to his overarching structures "… as living organizations … [that] are *causally active* in the *mind* of the subject" (p. 217, italics added).

Despite Piaget's affirmation, we think that his theory is mainly consistent with a non-reified view of developmental stages. This non-reified view is also consonant with Piaget's idea that his stages are descriptive tools, not explanatory factors. In fact, he stated that "… genetic [developmental] psychology seeks to envisage mental functions in their construction, and stages are the preliminary instrument for the analysis of these formative processes … I compare them to zoological and botanical classification, which is preliminary to analysis" (Piaget in Osterrieth et al., 1956, pp. 56–57).

A non-reified conception of developmental stages is also consistent with the constructivist epistemology that lies at the heart of Piaget's (and Kohlberg's) theories. For Piaget, to know is to operate upon reality rather than to follow internal and disembodied rules or a pre-existing mental logic (Carpendale & Atwood, 2013; Carpendale, McBride, & Chapman, 1996).

To sum up, diverse modes of theorizing about development and charting developmental change (Alexander & Langer, 1990; Case, 1985; Fischer, 1980; Overton, 2013; Overton & Lerner, 2012; Thelen & Smith, 1994; Tryphon & Vonèche, 2001; Van Geert, 1998) will yield different answers to the question "Where are developmental stages?" Positing that stages are aspects of the individual's brain functioning — as neuroscientists claim — or that they exist — as we think — as constructs put forward by theorists to characterize individuals' cognitive processes underlying their performances in certain tasks, amounts to adopting different conceptions of development and being developmental in different ways.

3. What features define a developmental sequence as a sequence of developmental stages?

Whether developmental stages exist as ontological entities in the external world, as reified entities in the mind or brain, or as useful heuristics posited by "embodied and contextualized" developmentalists to chart developmental change, we will still want to know what characteristics a developmental sequence should possess to be considered a sequence of developmental stages (Bady, 1978; Carpendale & Atwood, 2013; Flavell, 1970, 1982; Kesselring, 2013; Overton, 1998). Controversy about this issue also abounds.

For instance, over the last twenty years or so Overton (2013; Overton & Lerner, 2012, 2014) has been arguing for *relational-developmental systems*. Like Piaget's (1970, 1983a) holistic perspective (e.g., assimilation and accommodation are two sides of the same coin: one's active adaptation to the environment) and Bickhard's (2009) *interactive* model (reality is integrated because there are no isolable and independent grounds of reality, as would be the case if the world were made of Cartesian substances), Overton's relational paradigm rejects the many Cartesian dichotomies (e.g., nature vs. nurture, subject vs. object, brain vs. mind) that still pervade developmental psychology, let alone psychology in general (e.g., Baltes, 1987; Salthouse, 1992).

Even so, Overton (1998) distinguishes between *variational* or content-oriented change and *transformational* or structure-oriented change. According to Overton (1998), developmental stages refer more to transformational change (i.e., knowing better, for example, that an arithmetical operation of adding can be annulled by an arithmetical operation of subtracting) than to variational change (i.e., knowing more of "the same," such as first counting from 5 to 10, and then from 10 to 20).

We think that the distinction between transformational and variational change leads to two different conceptions of development: a strong conception and a weak one. Among other things (see above), in a *strong* conception of development five criteria (hierarchy, integration, consolidation, structuration, and equilibration) are necessary for developmental changes to defining a sequence of developmental stages.

Since there are other ways to think of development and developmental change (e.g., Fischer, 1980; Munakata & McClelland, 2003; Pascual-Leone, 1970; Thelen & Smith, 1994), including non-hierarchical models of development (see Alexander & Langer, 1990), no one is obliged to adopt a strong conception of development or even a hierarchical model of development. However, to the extent that developmentalists embrace a weak conception of development, the more likely they are (a) to have difficulty with being genuinely developmental; (b) to have trouble defining a sequence of developmental stages; and (c) use the concepts of development and developmental change vaguely and loosely.

Unfortunately, it is common in psychological research to use the same concept with different meanings. This procedure gives rise to otiose disputes (Modgil & Modgil, 1982, 1986). For instance, when Turiel (1983) speaks of the young child's moral sophistication, this has nothing to do with the moral sophistication that Kohlberg (1984) ascribed to post-conventional subjects. Paraphrasing Wittgenstein (1958), "… in psychology there are experimental methods and *conceptual confusion*" (p. 232e, italics in original). This astute remark is echoed in Horgan's (2001) words: "All the empiricism in the world can't salvage a bad [unclear] idea" (p. 27). However, the ghost of empiricism, one of many holdovers from Cartesian dualism (e.g., *res cogitans* vs. *res extensa*), continues, with few exceptions, to haunt the halls of academia, funding agencies, and editorial boards (see Overton, 2013).

To summarize, it is difficult, perhaps impossible, to think of a developmental sequence as defining a sequence of developmental stages if one adopts a weak conception of development, developmental change and developmental stages. The more one adopts such a conception, the more one is likely to use the concepts of development, developmental change, and developmental stages loosely and vaguely.

4. What psychological factors and processes underlie developmental change?

What leads to developmental change—how one explains the passage from one stage, level, and so forth, to the next, is the most

controversial and important issue in developmental psychology (Beilin, 1994; Dawson-Tunik et al., 2004; Feldman & Fowler, 1997; Johnson & Munakata, 2005; Piaget, 1985, 2001; Overton & Lerner, 2012, 2014; Scholnick, Nelson, Gelman, & Miller, 1999; Siegler & Jenkins, 1989; Valsiner, 1985).

We think that this controversy persists because of: (a) the plethora of approaches to psychological development (Miller, 2010); (b) the way one conceives of developmental change (Overton, 1998; Overton & Lerner, 2012); (c) the type of explanation (e.g., functional, structural) that developmental psychologists are primarily looking for (Piaget, 1968); (d) the empirical method one uses for assessing developmental change (Siegler & Crowley, 1991); and (e) the received view of Piaget's theory (Chapman, 1988). In what follows we elaborate on the answers provided by well-known approaches to the problem of developmental change and, for reasons that will become clear, reflect more on Piaget's answer to the problem of developmental change or the emergence of novelties.

According to the neo-Piagetian theorists Pascual-Leone and Johnson (2013), endogenous quantifiable changes in one's mental capacity, not associative learning mechanisms, are the main source of developmental change. In appealing to quantifiable maturational changes in one's mental capacity, working memory, and executive functions as the main factors that lead to developmental change, these authors are more neo than they are Piagetian. For Piaget (1971b), biological maturation is only one of the "three traditional" factors that lead to developmental change (see more below). Accordingly, some, if not all, neo-Piagetian theorists tend to overlook the underlying constructivism in Piaget.

According to the empiricist tradition, associative learning mechanisms, such as association between stimuli and responses or classical conditioning (Watson, 1913), positive and negative reinforcements or operant conditioning (Skinner, 1969), and social-cognitive learning (Bandura, 1977, 1986), are the sole source of developmental change. For these *traditional theories of learning*, development is nothing but accumulating learning (see Bijou, 1968, p. 423). In a traditional learning framework it does not make sense to speak about developmental stages—or any indicator of developmental change. In short, such theories are non-developmental, even anti-developmental.

It is possible to be developmental without positing stages. However, the less we posit stages, or use some conceptual tool to chart developmental change, the more difficulty we will have being truly developmental.

The *new* or *contemporary theories of learning* (e.g., Fischer & Grannott, 1995; Fischer & Rose, 2001; Halford, 1995; Pascual-Leone, 1995) aim to overcome the dichotomy between traditional theories of development (e.g., Piaget's theory) and traditional theories of learning (e.g., Skinner's). To overcome that dichotomy and account for developmental change, the new theories of learning appeal to ideas coming from varying approaches: Neo-Piagetian theories (e.g., Fischer & Bidell, 1998; Fischer & Grannott, 1995; Halford, 1995; see above), information-processing approaches (e.g., Salthouse, 1992), life-span developmental psychology (e.g., Baltes, 1987), bio-ecological accounts (e.g., Bronfenbrenner & Ceci, 1994), dynamic systems theories (e.g., Thelen & Smith, 1994; Van Geert, 1998), and specific-domain approaches (e.g., Hatano & Inagaki, 2000) are just five examples (see more below).

Seeking to go beyond the dichotomy between traditional theories of development and learning, new theories of learning deserve our attention. Among the problems they entail, however, are: emphasizing quantitative change at the cost of qualitative change; looking for antecedents of developmental change rather than its formal or structural pattern; and espousing a weak conception of development.

Learning plays a role in developmental change, yet development is more than compiling facts, accumulating knowledge, or coming to know "more of the same". Would it be possible, for example, to teach a 4-year-old to perform perfectly in a proportionality task? We think that every developmentalist would say: "It would not be possible." This means that there is something in development that is irreducible to learning, albeit in a weak conception of development all learning phenomena could be considered as a form of development.

In what follows, we elaborate on four of the five approaches that have inspired some, if not all, authors of contemporary or new learning theories, and also on other accounts put forward to explain developmental change. We say four, not five, because most proponents of the new approaches to learning are also neo-Piagetian researchers (e.g., Fischer, 1980; Fischer & Grannott, 1995), and neo-Piagetian theories were analyzed earlier in this paper.

Information-processing approaches appeal, for example, to speed and strategies of information-processing, working memory, and mental operations upon symbols (Salthouse, 1992; Siegler & Jenkins, 1989) to explain developmental change. The more the mind—envisioned as a computer working in a serial or parallel manner (Munakata & McClelland, 2003)—receives, stores, retrieves and transforms inputs and generates outputs, the more likely this activity is to lead to developmental change. However, for information-processing theories, developmental change is more gradual and quantitative than discontinuous and qualitative. But no strong conception of development exists if transformational, discontinuous change is precluded. In addition, information-processing theorists see the mind as a computer, promoting the view of mind as a disembodied, homunculus-like, reified internal entity. Contrary to what is assumed by those theorists, when we process information, we do that "as a whole," not as individuals with disembodied minds or brains.

According to *life-span developmental psychology* (Baltes, 1987), development is a life-long, multidirectional, multilateral, contextual, and dynamic process of growth in crystallized intelligence (e.g., one's vocabulary or general knowledge) and decline in fluid intelligence (e.g., one's inductive and deductive reasoning). Normative age-graded influences, history-graded influences, and non-normative influences (i.e., life events) operate throughout the life course, and, as a dynamic package, they are responsible for developmental change (Baltes, 1987, p. 621). We think, however, that this approach is weakly developmental for no strong developmental theory can exist without solid research on earlier phases of life, and most life-span research deals with adolescents, adults, and the elderly.

Life-span developmental psychologists could argue that Piaget's theory is also weakly developmental because his formal stage is the pinnacle of cognitive development, yet attained at adolescence. Because of this, some authors have proposed post-formal stages, which go beyond formal operations (e.g., Commons, Richards, & Armon, 1984). These higher stages are believed to be more flexible, complex, dialectical, and willing to deal with social, moral and intellectual complexities of one's everyday life than Piaget's formal stage (see Arlin, 1975).

It is true that Piaget viewed his formal stage as the pinnacle of cognitive development, but only in structural terms (see Inhelder & Piaget, 1958). However, Piaget did not believe that development came to an end with the achievement of formal operations for the formal structures can be infinitely elaborated, extended, differentiated, compounded and transformed (see Piaget in Bringuier, 1980). More to the point, Piaget (1987) held that development never ends. These two Piagetian ideas notwithstanding, no one seems to know of Piaget's notion of operations to the *n*th power, which are needed, among other things, to answer a fundamental question: what is required to be able to construct and evaluate

formal models of formal thinking?

According to *ecological approaches* (e.g., Bronfenbrenner, 1993a), developmental change greatly depends upon the several contexts or systems within which the child lives and develops. Bronfenbrenner thought that a person's development is affected by his/her surrounding environments. These range from the microsystem, which refers to the relationship between a developing child and the immediate environment, such as family and school, to the chronosystem, which encompasses change or consistence over time not only in the characteristics of the person but also of the environment in which that person lives (Bronfenbrenner, 1993b, pp. 37–40).

A more recent extension, the bio-ecological model (Bronfenbrenner & Ceci, 1994), further proposes that genetic heritage plays an important role in developmental change (Bronfenbrenner, 1993b, p. 41). This is hardly new because the role of genetic heritage in human development is also stressed, for example, by contemporary evolutionary psychologists (e. g., Cosmides & Tooby, 1992), neuroscientists (e.g., Damasio, 1999), and modularity theorists (e.g., Fodor, 1983). In addition, both Bronfenbrenner's ecological model and its more recent extension make no appeal to developmental stages or other marks of developmental progress. Because of this, this model is weakly developmental for no strong developmental theory can exist without a criterion or, at least, an indicator of developmental change.

This shortcoming notwithstanding, Bronfenbrenner's (1977) claim "… that much of developmental psychology is the science of the strange behavior of children in strange situations with strange adults for the briefest possible periods of time" (p. 513) is an astute remark. Yet Piaget (1930, 1951) made detailed, naturalistic observations of his three children during their first two years, not only in brief periods of time, or in strange situations. Note also that assessing developmental change over brief periods of time is not necessarily a shortcoming in developmental psychology. In fact, assessing developmental change in short periods of time is part and parcel of important microgenetic studies (e.g., Siegler & Crowley, 1991; Vygotsky, 1978). Parenthetically, it should be noted that the term "microgenesis" was used with a different meaning by Werner and Kaplan (1956), namely, as a means of providing genetic characterization of the structure and temporal dynamics of immediate experience, and, more generally, of any psychological process.

According to *dynamic systems theories* (e.g., Smith & Thelen, 2003; Thelen & Smith, 1994; Van Gert, 1998, 2000), the main source of developmental change is self-organization, or interaction among the components of a complex system without explicit instructions coming from within the individual's organism or from the external environment (Thelen & Smith, 1994, p. 564). This idea is echoed in Fischer and Rose (2001) proposal of "[a]n alternative framework for understanding learning and development [as] a dynamic approach that moves beyond the static one-dimensional ladder and builds on the concept of a constructive web of skills" (p. 6), and lies also at the heart of the emergent *sciences of complexity* or sciences that deal with complex systems, for instance, a double pendulum that moves in the gravitational field (Varela, Thompson, & Rosch, 1991).

Dynamic systems theories diverge from (1) empiricist views on developmental change, which judge developmental change to result from the external environment; and (2) domain-specific theories of knowledge and development (Wellman & Gelman, 1997) because, according to dynamic systems theories, the principle of self-regulation operates in every domain of knowledge. To a great extent, Fodor (1983) *modularity theory*, *contemporary evolutionary psychology* (Cosmides & Tooby, 1992), and *contemporary neuroscience* (Damasio, 1999; Gazzaniga, 2005) are domain-specific theories of knowledge and development because innate, specialized modules are central to these three psychological approaches.

However, the principle of self-regulation espoused by dynamic systems theories was also a central process advanced by Piaget (1985, 2001, see more below) to account for the emergence of developmental change and novelties. In contradistinction, structure, which is a key concept in Piaget's theory, has no place in Thelen and Smith (1994) dynamic systems approach. Because of this, this approach risks emphasizing a functional explanation at the cost of a formal, structural explanation. Piaget's theory is both functional and structural. Functional, for it appeals to functional invariants, such as assimilation, accommodation, and self-regulation, which are involved in any process of knowledge at every age. Structural, because the same way of psychological functioning in all individuals at every age gives rise to different structures and new forms of knowing as time goes by. As Piaget (1970) put it, "structures are inseparable from performance, from functions" (p. 69).

As alluded to earlier, the structure-function dichotomy — as well as other dichotomies, such as nature vs. nurture and individual vs. social — is also eschewed by Overton's *relational-developmental systems* approach (Overton & Lerner, 2012, 2014). According to Overton (2013), Piaget's theory is a paradigmatic example of his relational-developmental systems paradigm, a paradigm which is an alternative to all the kinds of Cartesian views that still abound in contemporary developmental psychology, let alone psychology in general (Kitchener, 2009).

Differently from *global-domain approaches*, such as Kohlberg's (1984) theory, for example, *domain-specific approaches* to developmental change (Wellman & Gelman, 1997) heavily rely on the idea that a person's mode of thinking, knowledge, and mechanisms of developmental change differ in important ways across distinct contents. Consequently, domain-specific theories are clearly at odds with the dynamic systems' thesis that developmental change arises from self-organization or interaction among all components of a complex system. Similarly, Fodor (1983; see also Chomsky, 1988) claim of different, separate, independent, and innate modules (e.g., a visual threat detection module, a grammar module, and so forth) to deal with input systems is at variance with dynamic systems' idea that an interaction among all components of a complex process without explicit instructions coming from within the individual's organism is the main factor in developmental change.

The idea of innate and prewired modules (e.g., the cheater detection module) is also a central idea in contemporary *evolutionary psychology* (e.g., Cosmides & Tooby, 1992; Van Lier, Revlin, & De Neys, 2013) or psychology that tries to identify which human psychological characteristics are evolved adaptations. By arguing for modularity, contemporary evolutionary psychologists distance themselves from dynamic systems theories because evolutionary psychologists think that much of human behavior results from adaptations that evolved to solve specific recurrent problems in an ancestral environment for *Homo sapiens*. As elaborated earlier in this paper, for neuroscientists (e.g., Bjorklund & Pellegrini, 2002; Damasio, 1999), developmental change is mainly the development of certain regions of the human brain, the frontal lobes in particular.

According to Vygotsky's (1978) *socio-cultural theory*, social interaction plays a fundamental role in developmental change. As he put it, "Every 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 then *inside* the child (*intrapsychological*)" (p. 57; italics in original). Vygotsky's (1978) idea that social interaction plays a central role in developmental change is clearly visible in his famous presentation of the zone of proximal development:

> What we call the zone of proximal development … is the distance between the actual developmental level as determined by

independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers (p. 86, italics in original).

Like Vygotsky, Piaget (1932) emphasized the role of the child's peers in his/her development, moral development in particular. However, Piaget put more value on collaboration with peers (i.e., a horizontal relationship) than on collaboration with more capable peers and with adults (i.e., a vertical relationship). Contrary to Piaget (1983a), Vygotsky (1978) subordinated development to learning. This shows that, unlike Piaget, Vygotsky espoused a relatively weak conception of development.

It is worth mentioning that the majority of the above mentioned accounts for explaining developmental change are looking for what factors or antecedents bring about developmental change — a *functional explanation* — rather than a formal/structural explanation. A *formal explanation* looks for the pattern, structure, or form that characterizes a given developmental change or stage (Piaget, 1968).

Although controversial (Modgil & Modgil, 1982; Siegel & Brainerd, 1978; Thelen & Smith, 1994), *Piaget's account of developmental change* is remarkable. To begin with, his account anticipated, and incorporated in a coherent, original way, ideas from several approaches, some of which made an independent appearance late in his career (interactivism, for example, dates from the early 1970s), or only after his death in 1980. Chiefly among those approaches are: (a) dynamic systems theories (Thelen & Smith, 1994) and their emphasis on the process of *self-regulation*; (b) the sciences of complexity (Varela et al., 1991) and their central idea that developmental change is a *complex process*; (c) Bickhard's (2009) *interactive* model, and its key idea that the only way that action systems and developmental change can be created is by *interaction* and *construction*; (d) Overton (2013; Overton & Lerner, 2014) process-relational paradigm, and its quest for *relational*, not dual, Cartesian-like perspectives; and (e) modern neuroscience (e.g., Damasio, 1999; Gazzaniga, 2005), and its emphasis on the role of the brain's *maturation* in developmental change.

More precisely, for Piaget, developmental change is due to the "three traditional factors" of development — biological maturation, physical experience, and social interaction, including language — and to complex processes such as equilibration and self-regulation (Piaget, 1985), reflecting abstraction (Piaget, 2001), conscious realizing (Piaget, 1976), dialectics (Piaget, 1980a), contradiction (Piaget, 1980b), opening to new possibilities (Piaget, 1987), finding reasons (Piaget, 2006), and so forth.

Given the relative paucity of knowledge about the brain during Piaget's career, he could not have gone much beyond generically recognizing the role of maturation in developmental change (Piaget, 1971b), and noting some relations between elementary action schemes and elementary aspects of the brain's functioning. For example, according to Piaget (1968), "… the coordination between vision and prehension is effectuated at around four and a half months [because of the] myelination of the pyramidal fissure." (p. 119).

For Piaget (1968), maturation is, to an extent, responsible for the invariant sequence of his stages. We say "to an extent" because you cannot, for example, have operations on operations without first having operations, and that is a logical or metaphysical constraint, having nothing to with maturation. Piaget held that the maturation of the nervous system simply opens up a series of possibilities but without giving rise to an immediate actualization of these possibilities. More to the point, maturation is undoubtedly never independent of a certain functional exercise where experience plays a role.

Of course, the role of the brain in general and certain regions of it in particular in developmental change is much more emphasized by neuroscientists (e.g., Damasio, 1999) and some neo-Piagetian authors (e.g., Pascual-Leone, 2013) than by Piaget and other developmentalists from his time (e.g., Kohlberg, 1984; Werner, 1957). There are now a plethora of neural techniques (e.g., functional magnetic resonance imaging) to measure the brain's activity when people think, feel, or act in a certain way that did not exist when Erikson, Piaget or Kohlberg formulated their theories of psychosocial, cognitive, and moral development.

Although recognizing the role of physical experience in developmental change, Piaget (1968) always opposed an *empiricist* conception of this form of experience, because even the simplest environmental influence is never passively received and registered, always acted upon. In other words, that external influence is always assimilated to the subject's cognitive structures, however elementary these structures may be (Piaget, 1930). Therefore, Piaget (1964) never conceived of physical experience as a mere copy of reality. Instead of, to know an object is to act upon it, and construct the systems of transformations acting on the object or participating in it.

Piaget (1995) always considered social factors a necessary condition of developmental change. In his words, "[i]t is therefore quite evident that social life affects intelligence through the three media of language (signs), the content of interaction (intellectual values) and rules imposed on thought (collective logical or pre-logical norms)" (Piaget, 1966, p. 156). This affirmation shows that the frequent thesis among Piaget's critics (e.g., Bruner, 1997) that his subject is a solitary individual relies on the received view of his theory (Kitchener, 2009).

Despite Piaget's emphasis on the role of social factors, including language, in the individual's development, he stressed that they are not sufficient for explaining developmental change. In addition, social factors are for Piaget (1962, p. 4) facts to be explained, not to be invoked without further examination as extra-psychological forces. Therefore, Piaget (1995) also rejected what could be called *sociological empiricism*; i.e., equating social interaction with simple exposure to others and acquisition of knowledge with mere knowledge transmission. For him, a social transmission works only to the extent that it is significant and it becomes significant only to the extent that there is a cognitive structure or stage of development which allows its assimilation.

This is the main reason why Piaget (1964, 1973), although accepting that, to an extent, training can accelerate the subject's operational competencies, such as class-inclusion and transitivity (Brainerd, 1973, 1974), remained skeptical about it (Piaget, 1964, 1983a): (1) Is such acceleration beneficial or detrimental to the child's development? (2) Is what is learned through acceleration lasting? (3) How much generalization is possible? And (4) what was the subject's stage of development before a given learning experience and what more complex structures has this training succeeded in reaching?

More than a factor or an independent variable of developmental change related to the "why" of development, *equilibration* or *self-regulation* (Piaget, 1985) is a complex process underlying all development change, hence, more related to the "how" of development (Boom, 2009; Campbell, 2009; Smith, 1993). In Piaget's (1985) words, equilibration is a "… process that leads from a state near equilibrium to a qualitatively different state of equilibrium (i.e., optimizing equilibrium or *équilibration majorante*) by way of multiple disequilibria and re-equilibrations" (p. 3). As Elkind (1968) put it, for Piaget, "…equilibration is, at all levels, the dynamic of cognitive change without which the effects of maturation, physical experience, and social experience cannot be understood or explained" (p. xiii). The more a subject is capable of equilibration

and self-regulation, the more s/he is prepared to compensate for "disturbances" or "perturbations" having to do with external contradictions and lacunae, internal limitations or gaps in knowledge.

Although important as a process of developmental change, Piaget realized that equilibration was not alone because other complex processes are also involved (see, for instance, Campbell, 2009; Kesselring, 2009; and above). Chief among them is the Piagetian process of *abstraction réfléchissante* or *reflecting abstraction* (Piaget, 2001).

Reflecting abstraction is a logicomathematical, not empirical, abstraction for "…it abstracts properties … of the inner co-ordinations among our actions" (Campbell, 2009, p. 153), and projects, transposes, or transfers them to a higher level. It consists of two steps. The first step — projection or *réfléchissement* — takes a structure at a lower developmental level and projects it onto a higher level. An elementary example of this projection is the child's capacity for thinking about or verbally describing his sensorimotor move from the kitchen to his/her room. This first step is constructive because a new level of abstraction is generated. The second step — reflection, reorganization, or *réflexion* — reorganizes the structure at the higher level, which, in its turn, becomes a substructure or content for a higher level of knowing (e.g., to understand that that sensorimotor move — an identity operation — can be canceled, for example, by an inversion or negation operation).

Some developmentalists (e.g., Bruner, 1959) have considered that the process of equilibration as a main source of developmental is vague, diffuse, and even "surplus baggage" (p. 365). Note that this Bruner's remark dates back to 1959. This means that he was rejecting Piaget's (1957) model of equilibration, torn up and replaced in Piaget's (1985) main book on equilibration.

Far from being surplus baggage, the Piagetian equilibration process coordinates into a coherent whole the three traditional factors of development (see above). Even so, Piaget was not totally satisfied with his explanation of developmental change, and was the first to recognize some limitations in his own theory. In fact, at the end of his main book on equilibration, Piaget (1985) confessed that he could not rejoice in a finished deductive theory, or with agreement with the data beyond a few intersections among the results of various investigations. However, he believed that he had moved beyond the descriptive level in a set of domains where it was now possible to invoke some "reasons" (Piaget, 2006), some functional and other structural. This confession also appears in his conversations with Bringuier (1980):

> It is my conviction, illusory or otherwise — and the future alone will show which part is truth and which but simple conceited obstinacy — that I have drawn a quite clear general skeleton, but one still *full of gaps* of such a kind that, in filling them, one will be led to differentiate its connections, in various ways, *without* at the same time *altering the main lines of the system* (p. 140, italics added).

As mentioned, much of the controversy about developmental change is related to the way one understands that change. Is developmental change cumulative, gradual, quantitative, variational and continuous, or discrete, qualitative, transformational and discontinuous? Dynamic systems theorists (Thelen & Smith, 1994), for example, assume that developmental change is quantitative and continuous. An example of developmental change as a discrete, qualitative, and discontinuous change is Kohlberg's moral stages, for they rely — so Kohlberg (1984) claimed — on a complete separation of moral content from moral structure. Carpendale and Krebs (1995), for example, have found that this separation is not always the case.

Piaget's theory is generally presented as one in which developmental change is qualitative and discontinuous because — it is said — developmental change comes out in a sudden burst. In contrast to this view, we think that in Piaget's theory developmental change is both a continuous and a discontinuous process. A discontinuous process because Piaget (1983a), for example, posited the existence of discrete stages, was more interested in the quality of one's intelligence than in its quantitative aspects, and did not use mental tests to assess cognitive development (Piaget, 1952). A continuous process because for him (Piaget, 1971b) nothing in development begins *ex abrupto* or suddenly, and cognitive development is an extension of biological growth.

In this vein, we believe that whether developmental change is continuous or discontinuous is an otiose dispute. If one assesses developmental change through a microgenetic method, that is, in brief periods of time (days, hours, or even a few minutes; see Miller & Coyle, 1999), the change will tend to appear as continuous. In contradistinction, the more one assesses developmental change over longer intervals (yearly or every several years), the more one is likely to think of developmental change in qualitative and discontinuous terms.

Recent accounts of *children's theories of mind* (i.e., a given child is supposed to have a theory of mind; developmentalists look for an explanation of the child's theory) try to explain how children come to understand that mental states, such as desires, beliefs, and intentions, are behind their and others' performances in certain tasks and everyday situations (Carpendale & Lewis, 2004; Chandler, 2001; Mitchell & Riggs, 2002). False-beliefs tasks are the main tasks used by theories-of-mind researchers (Wimmer & Perner, 1983). Findings have generally shown that, in contrast to 4-year-olds, children as young as 2 or 3-year-olds have difficulty with attributing false beliefs to others, and hence they have not yet a theory of mind (Chandler, Fritz, & Hala, 1989). Therefore, the age of 3–4 years represents a developmental milestone, not a stage, in children's understanding of their own and others' mental sates.

How does one explain this change? Very succinctly, for modular accounts of theories-of-mind, it is mainly due to neural maturation (Leslie, 1994). According to the "theory–theory" view, the predominant view among researchers in this area, that change depends on children's ability to meta-represent, that is, to understand a representation *qua* representation or understand the falseness of false beliefs (Perner, 1991). According to the simulation theory, the change reflects an increasing ability to simulate or imagine the experiences of others (Harris, 1991).

It is worth mentioning that the processes invoked by some theories-of-mind theorists are presented as resting on a solid "anti-Piagetian" footing (Perner & Astington, 1992, p. 146). But this is not required (Carpendale & Lewis, 2004; Chandler, 2001). Young children's difficulty with attributing mental states to others could be explained by the Piagetian concept of egocentrism/centration, or the young child's failure to clearly demarcate the objective from the subjective (Piaget, 1930, p. 242), or to take into account two different perspectives at the same time (Kesselring & Müller, 2011). In addition, it seems that in children's theories-of-mind one's understanding of mental states tops out at the age of 4–5 years (see, for a different perspective, Chandler, 2001). Because of this, those approaches are weakly developmental. A theory cannot be strongly developmental if it claims that development in some domains comes to an end as soon as it has begun.

To sum up, developmental psychologists appeal to different factors and processes that underlie and lead to developmental change. This difference has much to do with the psychological approach that one embraces, the type of explanation one is looking for, the empirical method used to assess developmental change, and the conception of development one adopts.

5. Should we abandon the concept of developmental stages?

Our answer to this question is that the classic concept of developmental stages still is relevant to developmental psychology. We see developmental stages as clear, useful heuristics or conceptual tools to identify and chart developmental change in various domains (e.g. Kohlberg, 1984; Piaget, 1983a).

Even so, the prevailing tendency has been for developmental psychology to jettison the stage concept in general, and Piaget's stages in particular (Fischer & Grannott, 1995; Flavell, 1982; 1985; Gopnik, 1996; Karmiloff-Smith, 1992; Thelen & Smith, 1994). We think that this tendency is largely explained by the weak conception of development underlying many psychological approaches (e.g., information-processing approaches) and widespread acceptance of the received view of Piaget's theory.

In some previous sections we have shown that the weaker a theory is developmentally, the more it will claim that developmental stages should be jettisoned. In what follows, we elaborate a bit more on how the received view of Piaget's theory helps to convince developmentalists that stages are doomed to being abandoned.

1. To begin with, this received view wrongly assumes that Piaget's theory adopts — as information-processing approaches do (e.g., Klahr, 1992) — a narrow, computational view of representation. Although he posited representation in a broader, non-computational sense (see Chapman, 1988; Piaget, 1951), Piaget (1964, 1983a) aimed more at a constructivist than a representational view of development and knowledge. That is, for Piaget to know an object is to act upon it, and construct the transformation systems acting on the object or participating in it rather than to form an image of such an object. This idea is well documented in Inhelder and Piaget (1969) words:

> A cube is perceived as a thing which can be handled and turned over and turned around … [and] to perceive a house is not to look at an image which has gone into your eyes [mind or brain], but to recognize a solid shelter for you to get into (p. 13).

2. Another claim is that developmental psychology should abandon developmental stages because they are wrongly assumed to have explanatory value. In Brainerd's (1978) words: "… whereas Piaget's stages [and developmental stages] are perfectly accepted as descriptions of behavior, they have no status as explanatory constructs" (p.173). However, when critics state that Piaget's stages are primarily descriptive, they are not saying anything that Piaget had not recognized. He compared stages to zoological and botanical classification in biology, which is preliminary to analysis (Piaget in Osterrieth et al., 1956, pp. 56–57).

3. Brainerd (1978), as well as other critics (e.g., Larivée et al., 2000; Siegel & Brainerd, 1978) still argue that developmental stages, Piaget's stages in particular, have no future in developmental psychology for they appeal to an extreme competence theory, according to which the child's performance in a given task depends only on her competence and has nothing to do with performance factors, such as the content of the task, the context in which it is presented to the child, and so forth. This idea also relies on the received view of Piaget. Suffice it to say, for instance, that for Piaget "…we never attain a measure of comprehension in a *pure* state, but always a measure of comprehension *relative to a given problem and a given material*." (Piaget & Szeminska, 1980, p. 193; italics added). As noted earlier, the late Piaget (1972) maintained that individuals can be formal in certain areas, but not in others. If "competence" is meant in Chomsky's (1988) sense, Piaget's theory cannot be a competence theory, because it would have to presuppose that correct descriptions of what the child can do

automatically also describe what the child knows and explain what the child does.

4. Developmental psychology should jettison developmental stages, Piaget's in particular, because Piaget's theory predicts developmental synchronies not corroborated by data. It is true that some studies designed to test the developmental synchrony supposedly "predicted" by Piaget's theory have generally found asynchrony and décalage, both in concrete and formal operational tasks, for example (e.g., Bond, 2010; Brainerd, 1973). For some of Piaget's critics, these finding are a serious anomaly for his (structural) theory because they refute one of its empirical predictions, requiring its abandonment in future developmental research (Flavell, 1982). Note, however, that Piaget was the first to report (horizontal or within-stage) décalage, for example, on a variety of conservation and classification problems! (See Inhelder & Piaget, 1969; Piaget & Szeminska, 1980).

5. Developmental psychology should abandon developmental stages, Piagetian stages in particular, because Piaget's appealed to three disconfirmed assumptions: people at a given time function only at one stage, solitarily, and according to one pathway (Fischer & Grannott, 1995, pp. 304–305). Again, these assumptions rely on the received view of Piaget, a view in which a particular interpretation of Piaget's thought is being utilized as it if were Piaget's own thought (e.g., Brainerd, 1978). In fact, Piaget (1972) made it clear, for example, that formal thinking exists in some domains but not in others, that without interchange of thought and cooperation with others the individual would never come to group his operations into a coherent whole (Piaget, 1966, p. 163), and that development could follow psychogenetic pathways different from the one he had identified (Piaget in Bringuier, 1980, p. 100).

6. Developmental stages, including Piaget's, should be jettisoned because they are too global and vague (Brainerd, 1978). How can it be said that Piagetian stages are too vague? Note, for example, that performances and cognitive processes linked to the preoperational stages are described as those in which there is a predominance of (a) centration over decentration; (b) irreversibility over reversibility; (d) affirmation over negation; (e) configurations over transformations; (e) irrelevant transformations over relevant transformations, and so forth. In addition to these descriptive characteristics, such performances can be formalized in terms of functions, identities, correspondences and morphisms (see, for example, Piaget, Henriques, & Ascher, 1992).

To sum up, the reasons for abandoning developmental stages are mainly based on the received view of Piaget's theory and a weak conception of development. If developmental psychology loses sight of developmental stages, what is the better and clearer concept for charting and characterizing the new, qualitatively different forms of knowing and thinking that emerge, develop, and attain full maturity over time? More than any other, the concept of developmental stages is suitable for that purpose. By its very nature, it makes us think of development in terms of transformational, integrative, hierarchical, sequential and directional change. Developmental stages have also a long history in developmental psychology. It really does seem that if stages did not exist, we would have to invent them.

6. Concluding remarks

In the article, we have presented a critical review of the main answers that have been given to five controversial questions regarding the concept of developmental stages, Piaget's stages in particular, while arguing for a strong conception of development and a non-received view of Piaget's theory. Do developmental stages exist? We think that they exist and that they are clearer conceptual tools than other putative devices (e.g., levels, periods,

phases, cycles, layers, or seasons) to chart developmental change. If developmental stages exist, where are they? We think that they exist, not as reified entities in each person's mind or brain, but as *a priori* conceptions posited by many developmentalists to chart developmental change and characterize the descriptive and formal properties of subjects' performances and cognitive processes in certain tasks or situations. What properties should a developmental sequence have in order to be considered a sequence of developmental stages? Adopting a strong conception of development, we believe that in order to be considered a sequence of developmental stages, it has to be, among others things, invariant, hierarchical, integrated, structured, and equilibrated. How does one explain developmental change? We think that, among the myriad of explanations offered to this question, Piaget gave an original, although not definitive, answer to this question. His answer takes into account the three traditional factors of development and coordinates them all by invoking complex processes such as equilibration, reflecting abstraction, and so forth. In so doing, he anticipated processes of developmental change (e.g., self-regulation), which were adopted later by other prominent developmental figures (e.g., Thelen & Smith, 1994). Should we abandon the classic concept of developmental stages? In sharp contrast to many authors, we think that developmental stages were useful heuristics to chart development changes in the past (e.g., in Piaget's theory and Kohlberg's), are useful constructs for identifying and charactering developmental change in the present (Feldman, 2004; Müller et al., 2009a), and probably will continue to be useful constructs in future development psychology.

Some readers may wonder whether this paper is about developmental stages or the critique and defense of Piagetian developmental theory. It is about both. More than any other, Piaget's theory has been the most influential in shaping empirical research and theoretical debate in developmental psychology, about developmental stages in particular. There are: (a) *Piagetian* theories (e.g., Kohlberg's moral theory); (b) *neo-Piagetian* theories (e.g., Case's theory of intellectual development); (c) *post-Piagetian* theories (e.g., Commons et al.'s model of cognitive development beyond Piagetian formal operations); (d) *anti-Piagetian* theories (e.g., Perner's approach to children's theories of mind); and (e) even *neo-neo-Piagetian* theories (e.g., Bickhard's interactive model of development). We do not know of any other psychological theory that has received all five prefixes. As amply shown in this review, Piaget's theory is implicated in the majority, if not all, of accounts addressed here. It is understandable that Piaget's theory and its critique/defense would constitute the main background for a grounded, comprehensive discussion about developmental stages and issues related to them.

Some readers may say that too many issues are discussed in one piece. Note, however, that all those issues are explicitly related to the five developmental questions on which the present paper is focused. In addition, we wanted to present a comprehensive critical review of the main answers to those questions.

Other readers of this article may argue that this critical review does not present a new perspective. This remark expresses the widespread idea that if you have no new theory to propose, then it is better to say nothing. But if progress in a science was a function of the number of theories that that science offers, then psychology ought to be the queen of the sciences. This we definitely know is not the case. Although does not present a new perspective, the present critical review addresses the main responses to each of the five mentioned questions in a novel way, that is, by arguing for a strong conception of development and a non-received view of Piaget's theory. Thus far, there is no paper in the vast developmental literature doing what the present critical review does.

The present paper often refers to the received view of Piaget's theory and to its many misunderstandings. Readers of this review may ask why Piaget's theory has been so misinterpreted. There are several reasons. Chief among them are the following:

First, like any other grand psychological theory, such as Freud's (1968), Skinner (1969), and Kohlberg's (1984) approaches (Modgil & Modgil, 1986, 1987; Webster, 2005), Piaget's (1983a) theory was doomed to being interpreted in different ways and even to being misunderstood (Modgil & Modgil, 1982). Similar things have happened to grand theories in other disciplines, such as Darwin's (1962) theory of evolution (see Coyne, 2009). Darwin (1962) affirmed a long time ago that "[g]reat is the power of steady misrepresentation; but the history of science shows that fortunately this power does not long endure" (p. 421).

Second, some years ago Zeaman (1959) has pointed to a common, albeit unnoticed, procedure in scientific research and theorizing in different fields. Whereas in "… the natural sciences, each succeeding generation stands on the shoulders of those that have gone before …, in the social sciences each generation steps in the face of its predecessors." (p. 167). Thus, it may be the case that when psychological theories appear, their proponents and followers prefer to step in the face of their predecessors. As amply shown in this critical review, Piaget's theory was frequently subjected to such a procedure. In the process, it was misunderstood in several respects.

Third, Piaget considered himself to be mainly an epistemologist. Genetic (developmental) psychology was for him a means to "test" his epistemological assumptions, such as his constructivist claims. Many theorists and researchers (e.g., Flavell, 1963; Gelman & Baillargeon, 1983) have thought of Piaget more as a psychologist than an epistemologist. The fact that Piaget's three big books on epistemology (Piaget, 1950a, b, c) have still not been translated into English only compounds the problem. When three main (epistemological) books are not being read, a comprehensive understanding of Piaget's theory is almost impossible.

Fourth, "Overall, Piaget published 88 authored or edited books in French; yet 38 … are still unavailable in English … The pattern is the same or worse for Piaget's papers." In addition, English translations of Piaget's books are not without their problems, which include "pseudo-translation, incomplete translation, inconsistent translation into the same book, inconsistent translation between different books, mistranslation, and typographical error." (Müller, Carpendale, & Smith, 2009b, p. 29). As many of Piaget's critics are native English speakers, it is feasible that missing and poor translations are an additional reason for their misunderstanding of Piaget's theory.

Fifth, as mentioned earlier, during a career of nearly 60 years, Piaget introduced changes into his theory. These changes have led some developmentalists to speak about Piaget's new theory (e.g., Beilin, 1992b). But post-1965 Piaget seems to be unknown by some of his critics (e.g., Brainerd, 1978; Siegal, 1997). In addition, some neo-Piagetians (see above) may consider his writings after 1965 to be unnecessary and unwelcome competition with their own work.

Sixth, Piaget's (1952) famous *clinical* or *critical* method has nothing to do with null hypothesis significance testing, which pervades most empirical research in developmental psychology, not to mention in all of the other areas (Meehl, 1978). Piaget's clinical or critical method is at variance with the "…Anglophone diet of standardized, objective, and experimental scientific method where results were routinely presented following some sort of routine statistical analyses" (Bond & Tryphon, 2009, p. 171). Some of Piaget's critics (e.g., Siegal, 1997) also fault his method for appealing too much to justifications, counter-suggestions, and repeated questioning when children are interviewed in Piagetian tasks. According to such critics, these procedures may hide the child's true cognitive competence. However, far from being a

nuisance in Piaget's clinical/critical method, such procedures are quintessential to assess the child's idea of logical necessity. As epistemologist, Piaget (1986, 1983b) was highly interested in knowing how the new forms of thinking which appear and develop over time become necessary once constructed.

Finally, Piaget bears his own responsibility for being misunderstood: (a) on some occasions (e.g., Piaget, 1941), he referred to his overarching structures as if they were factors or antecedents of developmental change. This article, among others, may have led some authors (e.g., Brainerd, 1978) to think of Piagetian stages as explanatory rather than descriptive concepts; (b) although being highly prolific on many important issues (Gruber & Vonèche, 1995), Piaget wrote, sometimes confusedly, in a language that much of his audience could not read. Note, for example, that when the Piagetian term "*abstraction réfléchissante*" is rendered in English, there appear two different translations: *reflective abstraction* (Gruber & Vonèche, 1995, p. 873), and *reflecting abstraction* (Campbell, 2009, p. 153). Some might have been led to conclude that reflective abstraction and reflecting abstraction are two different processes of developmental change; and (c) The clinical/critical method was the preferred method that Piaget used for collecting and interpreting the data that are reported in most of his books. Yet Piaget used the introduction to just one of his many books to characterize his famous method (Piaget, 1952). This certainly did not promote understanding among developmental psychologists who were not themselves trained in it (e.g., Siegal, 1997).

In his conversations with the French journalist Jean-Claude Bringuier, Piaget had the following to say about theories:

> When one theory succeeds another, the initial impression is that the new one contradicts the old and eliminates it, whereas subsequent research leads to retaining more of it than was foreseen. My secret ambition is that the hypotheses one could oppose to my own will finally be seen not to contradict them but to result from a normal process of differentiation" (Piaget in Bringuier, 1980, p. 144).

Borrowing from Piaget's secret ambition, our secret, humble ambition is that the present paper (1) shows that when a new theory (let alone a new critical review) appears it retains more of previous theories (and critical reviews) than was foreseen. If new research, hypotheses, theories or reviews result from a normal process of differentiation and integration, then no hypothesis, theory or review is totally new, for its *raison d'être* and its very existence are partly due to previous research, hypotheses, theories, and reviews. Paraphrasing critic John Horgan (1999), "theories of human nature never really die; they just go in and out of fashion" (pp. 6–7); (2) documents that the remarks one could make about the present critical review will finally be seen not to eliminate its relative novelty and usefulness but to result from a normal process of differentiation from, and integration into, previous critical reviews of the concept of developmental stages, Piaget's stages in particular. By arguing for a strong conception of development and a non-received view of Piaget's theory, we have tried appeal to a clear—as opposed to a vague and loose — concept of development and developmental stages, and to an interpretation of Piaget's theory that steers clear of the usual misunderstandings. Note that, as Laudan (1977) pointed out: "The increase of the conceptual clarity of a theory through careful clarifications and specifications of meaning is one of the most important ways in which science progresses" (p. 50); (3) helps to show that dominant concepts and research paradigms can be analyzed from different points of view, which will reveal their strengths and limitations. Because of such limitations, even the grand theories of psychological development— such as Piaget's and Kohlberg's theories—eventually will

fade and will replaced by more progressive research programmes (see Lakatos, 1978); (4) contributes to a better understanding of the main responses to the five (developmental) questions addressed in this review; and (5) points to the strengths and limitations underlying those responses, namely when it shows that most of those responses rely on a weak conception of development and a "received" view of Piaget.

It is said that Alexander the Great (356-323 BC), king of Macedonia, once asked his tutor, the geometer Menaechmos (380-320 BC), to teach him a shortcut to mastery of geometry. Menaechmos is alleged to have replied that for traveling through Alexander's country there were royal roads and roads for common citizens, but in geometry there is only one road, and this (difficult) road is the same for all people (see, for instance, Heath, 1921).

We psychologists often appeal to shortcuts in our otherwise ingenious endeavors to conduct research, advance new theories, make critical reviews, and so forth. However, the more often one chooses a shortcut, not a rigorous track, the more one is likely to be lost in the interim, and the less one is likely to accomplish the intended goal.

Acknowledgments

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