Subitizing and Simultaneous Perception of Objects

in Renaissance and Early Modern Psychology

O. Dubouclez (ULg)

I

“Subitizing” is the ability to judge the numerosity of simultaneously presented objects without any counting[[1]](#footnote-1). As you can see on the hand-out, it is easy to identify a group of 2, 3 or 4 items immediately and accurately, but for an array of 6 or more, you will certainly need to count them to know how many they are. In cognitive psychology, “subitizing” is viewed as a skill indicating that humans have an intuitive apprehension of quantities, what Stanislas Dehaene calls a “Sense of number”[[2]](#footnote-2). What I would like to suggest today is that descriptions of something similar to this “sense of number” have been given by philosophers and that the ability to immediately grasp quantities has played a specific role in the science of the soul. Here is an example taken in the 14th century theologian Gregory of Rimini:

“Let us consider five items, for instance two men here and three there. One can know with evidence that these three men are more numerous that those two and formulate it mentally with a demonstration. Therefore these three men can be apprehended with distinction as well as those two. Otherwise it would not be known with evidence that these are three and those are two. But it is clear that one cannot distinctly apprehend and know them unless distinct acts are performed; therefore, etc.”[[3]](#footnote-3)

Gregory of Rimini is tackling the question whether it is true that “neither in the intellect nor in the will many acts can be at once”[[4]](#footnote-4). Is there any plurality or diversity in our thoughts, or is it the case that we always have one thought and then another in a strictly successive order? The text quoted above is considered by Gregory as a mental experience supporting what I will call the “simultaneist thesis”[[5]](#footnote-5): the fact that we can compare two groups of items and to pronounce without any hesitation or mistake that one is bigger than that the other implies that we hold a correct representation of each group in our mind. In fact, three different acts are simultaneously performed: the perception of the first group, the perception of the second one, and the comparison between the two. If some time was required or if counting was necessary to get a correct estimation of each group, Gregory’s argument would not hold. Indeed, I do not immediately know that there are five items, while I immediately know they are two here and three there. I apprehend one group and another one in the same instant, but I will need to make a quick addition to know that they are five.

We can find a lot of similar examples in scholastic philosophy from the 14th Century up to the 17th century. The ability to form accurate numerosity judgments is often used to defend the “simultaneist” thesis. At the end of the 16th Century, one the most influential textbook of philosophy, written by the Fathers of Coimbra, entails the following argument:

“Every time many things are known distinctly, they are known as many; but we can see three columns distinctly; therefore we can know them as many, with the sense as well as with the intellect: what is perceived by the sense, the intellect, indeed, seizes it at the same time.”[[6]](#footnote-6)

The idea that what is perceived by the senses is also apprehended by the intellect is an old one: if I can *see* many things at once, then I can *think* many things at once. If it is true that I see those three columns on a sheet of paper at the same time, that is that I do not see one of them before the others or better than the others, then it is a proof that I can understand many things at once. The situation is very similar to the one we had in Gregory’s text: The Coimbrian Fathers claim that each column is distinctly perceived, that none of them is confused or less distinct than the others, and therefore that three different acts of intellection are present in our mind while looking at them.

II

To understand what is really going on here, we need to clarify the polemical background of the problem.

Of course, it is very tempted to reject the “three columns” argument and to say that we apprehend those three columns as one thing made of three parts, and that there is only one mental act. This is Thomas Aquinas’s position who vehemently rejects the “simultaneist thesis”. According to him a diversity can only be apprehended as one, “per modum unius” which can happen in two different manners: 1) either we have a common representation through which we consider a plurality (for instance, the concept of “dog” representing all dogs); 2) or we see a bunch of different things as one whole, like a house made of walls, windows and doors. In this latter case we have a “unity of composition” made of a plurality of elements articulated together in such a way that there is one prevailing “species” and then secondary elements connected to it. If I perceive the house, I “primarily” perceive the whole of the house and I also perceive, but only “ex consequenti”, all the parts of the house. Aquinas also says that I have an “actual” perception of the house as such and a “potential” perception of its parts. If I want to have an actual perception of a window, I can focus on this or that part of the house, but I will not have an actual perception of the house anymore[[7]](#footnote-7). What is not actually and distinctly perceived is perceived confusedly. Therefore there cannot be more than one distinct representation or intellectual act in my mind at the same time.

Thomas Aquinas defends a highly centred or focused pattern of human perception. It is indeed an epistemological claim: we can apprehend only one “species” corresponding to the only one “form” that actually defines the object of perception. Grasping different things distinctly and at the same time would amount to grasping different “species” at the same time, which is impossible according to the Aristotelian conception of knowledge[[8]](#footnote-8). But what happens if I compare two different things or if I coin a judgment about two different things? Is it not the case that I have two different species at once? According to Sylvester of Ferrara, a 16th Century Thomist, I will apprehend them as united by what he calls a “representative similitude”, that is to say a “species” caused by the intellect on the basis of the two species perceived, a *species* of *species*, so to speak. If I say “Man is not a horse”, I do not have a representation of man and horse at the same time, I have a representation of their difference, a “similitude or representative conception of the difference between man and horse”. Such a “similitude” or “ratio” is the true object of thinking[[9]](#footnote-9).

The Thomistic conception is obviously problematic when it comes to the perception of plurality. Is it true that my perception is always focused on one prevailing thing? Is it true that what I do not actually perceive is confused and secondary? Francisco Suarez makes an interesting reply to Thomists at the end of 16th Century:

“Indeed when I perceive two men, I do not see them as one, since I do not compare one with the other and do not make one out of them. The intellect can consider them in the same way. The reason is indeed that the attention of the intellect has extension, and that it can be applied to knowledge either totally or partially. Therefore it can know one thing with half of its attention and then another with another part of attention. In a similar way, the intellect can know many things at once when constituting the difference between them or comparing them in one way or the other. Therefore it can also know them absolutely without any comparison.”[[10]](#footnote-10)

I do not see John and Paul as one, I see John *and* Paul; I recognize them as they are and where they are as two individuals. This argument is turned against the Thomistic idea that the apprehension of a group of objects necessarily implies a synthetic act of the intelligence like comparison. I can perceive two different persons walking in my direction, or three columns on a sheet of paper without performing any other act than grasping those objects. But Suarez introduces an extra element: attention. I can think many things at once because my “intellectual attention” can be divided: I may have one vision of John and Paul with two different acts of attention within it, one focused on John, the other on Paul. Suarez says more about this notion of intellectual attention in his *De Angelis*. Angels are free to divide their attention to grasp many things at once. Such a simultaneous apprehension implies that they cannot have a perfect apprehension of each. However, Suarez does not infer that such an imperfect apprehension must be confused or only potential. Suarez claims that, although they are less perfect and less intense than one act, there can be a kind of distinction in simultaneous acts. This is true for angels but also for humans.

This conception originates in the Scotist idea that “the distinct knowledge of an object with parts presupposes the distinct knowledge of its parts”[[11]](#footnote-11). The knowledge of the parts of the object is neither confused nor virtual when I know the object distincly; it is less intense, but it is involved in the building of the distinct knowledge of the whole. Implicitness is not confusion. If I do not see the door, the windows, the bell next to the door distinctly, then I can only have a confused perception of the house. The use that Suarez makes of the concept of intellectual attention is to be understood in a similar way: attention is a kind of multi-intentional force than can be oriented towards various objects, and this is how he accounts for “subitization”.

III

In my last part, I would like to suggest that Descartes has shared the Simultaneist Thesis. No only he openly defends it in his *Conversation with Burman*, not only simultaneity is crucial to his theory of deduction in the *Rules for the Direction of the Mind*, but he also needs it in his *Metaphysical meditations*. I would like to concentrate on a passage of the Sixth Meditation where the notion of simultaneous apprehension is applied to the knowledge of geometrical objects. Descartes wants to show that imagination has a concrete link to the body[[12]](#footnote-12) and, therefore, that it is really distinct from intelligence that has no such relationship. The question to know how many items can be present at once to the attentive mind is at the heart of his demonstration:

“When I imagine a triangle, for example, I do not merely understand that it is a figure bounded by three lines, but at the same time I also see the three lines with my mind’s eyes as they were present before me. But If I want to think of a chiliagon, although I understand that it is a figure consisting of a thousand sides just as well as I understand the triangle to be a three-sided figure, I do not in the same way imagine the thousand sides or see them as if they were present before me. It is true that since I am in the habit of imagining something whenever I think of a corporeal thing, I may construct in my mind a confused representation of some figure; but it is clear that this is not a chiliagon. For it differs in no way from the representation I should form if I were thinking of a myriagon, or any figure with very many sides.”[[13]](#footnote-13)

Descartes insists that the relationship between imagination and intellect is based on a “habit” and has nothing to do with the very essence of the mind: I “usually” have an image when I apprehend something corporeal, even in the case of corporeal things whose complexity is beyond the design ability of my imagination (for instance, chiliagons and myriagons, which I cannot “imagine […] in [their] entirety all at once” as Descartes says to Gassendi in the *Fifth Replies*[[14]](#footnote-14). Interestingly, the fact that I only have a confused image of the chiliagon does not lead to any positive conclusion regarding the relationship of imagination and body. Descartes needs to introduce a third example:

“But suppose I am dealing with a pentagon : I can of course understand the figure of a pentagon, just as I can the figure of a chiliagon, without the help of the imagination ; but I can also imagine a pentagon, by applying my mind’s eye to its five sides and the area contained within them. An in doing this I notice quite clearly that imagination requires a peculiar effort of the mind which is not required for understanding ; this additional effort of mind clearly shows the difference between imagination and pure understanding.”

The notion of “effort” or “contentio animi” is here crucial. Indeed, such an effort occurs neither in the case of the triangle (since I can imagine it easily)[[15]](#footnote-15), nor in the case of the chiliagon: I cannot even try to sketch a chiliagon inside of me; it is far beyond the limits of my mental imagery and, as a consequence, I have no experience of myself imagining it. I stick to a confused image of it that requires no effort because it has no specific determination. With the pentagon, on the contrary, the meditator reaches the concrete limits of his power of simultaneous apprehension: he can feel the difficulty of imagining a five-sided figure because he is actually doing it. And this effort or resistance is what makes him aware of the difference between imagination and intellect: they are not only different as concepts and images, but also as different experiences of oneself. Acts of imagination entail something that “is not a necessary constituent of my own essence, that is, of the essence of my mind” and “it depends on something distinct from myself”, namely an existing body that actually restrains my mental activity. It is only because simultaneous apprehension is possible and has also a limit that Descartes succeeds in disentangling imagination from intellect[[16]](#footnote-16).

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Let me conclude. Subitization designates a mental skill that philosophers have recognized and used to defend the idea that the human mind can grasp many objects at once and therefore can perform many mental acts at once. This is indeed a *quæstio* developing from the Middle Ages to Early Modern philosophy, putting into question the very status of confusion and distinction, but also suggesting that the perception of multiplicity is a specific phenomenon that the Aristotelian theory of perception, based on form and species, cannot explain. Simultaneity might also be an important aspect of Descartes’ theory of knowledge since the very use of geometrical figures, namely of mathematical imagination as described in the Sixth Meditation, plays a major role in the building of Cartesian science.

1. Mandler, G., and Shebo, B.J. (1982). Subitizing: An analysis of its component processes.Journal of Experimental Psychology: General, 111, 1‑22. 1982 ; Tryck & Pylyshyn, 1994. **Mandler et Shebo (1982) :** Le subitizing reposerait sur la reconnaissance de configurations canoniques : 1 serait un point, 2 serait une ligne, 3, un triangle… A partir de 4, il y a plusieurs formes possibles (un carré ou un triangle et un point isolé,…) **Trick et Pylyshyn (1991-1994) :** Ils introduisent le concept nouveau de Finst (finger of indentation Theory). Selon eux, le subitizing aurait son origine dans une étape pré-attentionnelle de la vision. La limite à 4 serait la conséquence du nombre limité de Finst (tags) : le finst serait un index spatial qui viendrait automatiquement s’attacher aux objet de la collection (un tag numérique qui s'accolerait automatiquement). Ce phénomène présente de sérieux avantages évolutifs, ce qui pourrait expliquer son apparition et son maintien, mais également son indépendance par rapport au processus cognitifs de dénombrement, plus complexes : ce serait seulement une autre forme cognitive de calcul/dénombrement. [↑](#footnote-ref-1)
2. Revkin 2008, cité par Dehaene. Subitizing is not an accurate form of estimation as it was recently established and it seems a skill already present in babies [↑](#footnote-ref-2)
3. « Secundo, datis quinque rebus, verbi gratia hominibus duobus hic et tribus illic, potest aliquis evidenter cognoscere quod hi tres sunt plures duobus illis et sic demonstrando mentaliter enuntiare. Igitur potest istos tres distincte apprehendere, et similiter illos duos ; alioquin non evidenter cognosceret istos esse tres et illos esse duos. Sed constat quod non possunt distincte apprehendi et cognosci nisi actibus distinctis ; igitur, etc. » (*Ibid*., p. 203, 20-25). [↑](#footnote-ref-3)
4. « nec in intellectu nec in voluntate possint simul esse plures actus » (**Gregorii Ariminensis OESA Lectura super primum et secundum ..., Volume 1** p. 201, 21) [↑](#footnote-ref-4)
5. Cf gregory « Ut docet experientia imaginanti illas intrinsecus » (*Lectura*, t. 1, p. 203, 10-14). [↑](#footnote-ref-5)
6. « Quoties cognoscuntur multa distincte, cognoscuntur ut plura, sed possumus simul videre distincte tres columnas ; ergo possumus eas ut plura cognoscere, idque etiam sensu quam intellectu : cum ea, quæ sensus percipit, intellectus simul intelligat. » (*In tres libros De anima Aristotelis*, ch. 8, q. 6, art. 2, Cologne 1603, c. 501) [↑](#footnote-ref-6)
7. Thomas d’Aquin, *Sentencia libri de sensu et sensato*, dans : *Opera omnia*, ed. Leon. 45.2, Paris 1985, p. 45, 101-111. Voir aussi *Somme théologique*, q. 85, art. 4, dans : *Opera Omnia*, ed. Leon. 5, Rome 1889, p. 339 : « Ad tertium dicendum quod partes possunt intelligi dupliciter. Uno modo, sub quadam confusione prout sunt in toto : et sic cognoscuntur per unam formam totius, et sic simul cognoscuntur. Alio modo, cognitione distincta, secundum quod quælibet cognoscitur per suam speciem : et sic non simul intelliguntur ». [↑](#footnote-ref-7)
8. It comes form Algazel. [↑](#footnote-ref-8)
9. François Sylvestre de Ferrare, *Quæstiones in tres libros de anima Aristotelis*, q. 14, Venise 1619, p. 208. [↑](#footnote-ref-9)
10. Nam quando video duos homines, non video illos per modum unius, quia nullo modo confero unum ad alium, nec ex illis facio unum. Et eodem modo potest intellectus illos considerare. Et ratio est, nam attentio intellectus habet latitudinem, et potest totaliter vel ex parte applicari cognitioni ; ergo potest unum cognoscere dimidiata attentione, et deinde aliud alia attentionis parte. Item, intellectus potest simul plura cognoscere, constituendo differentiam inter illa, vel aliquo modo comparando ; ergo etiam potest illa absolute cognoscere sine comparatione [↑](#footnote-ref-10)
11. *Ibid*., p. 95, c. 2 : « Cognitio distincta alicujus habentis partes præsupponit distinctam cognitionem partium ». [↑](#footnote-ref-11)
12. “An application of the cognitive faculty to a body which is intimately present to it, and which therefore exists”Descartes sais in the Second Meditation that imagining is “contemplating the shape or image of a corporeal thing” [↑](#footnote-ref-12)
13. « Par exemple, lorsque j’imagine un triangle, je le conçois pas seulement comme une figure composée & comprise de trois lignes, mais outre cela je considère ces trois lignes comme présentes par la force & l’application intérieure de mon esprit (*simul etiam istas tres lineas tanquam presentes acie mentis intueor*) » [↑](#footnote-ref-13)
14. CSM, p. 264; AT, VII, 385. [↑](#footnote-ref-14)
15. The French translation introduces the idea that the three lines of the triangle are « présentes par la force & l’application de mon esprit » to translate « acie mentis » in the latin and is very close to the way the meditator speaks of the pentagon that he imagines « en appliquant l’attention de mon esprit à chacun de ses cinq côtés ». While the very thesis of Descartes appears more clearly, the translation makes the steps of argumentation less obvious. The example of the pentagon does not look as necessary as it is in the Latin text. [↑](#footnote-ref-15)
16. See K. Branhorst’s reading, *Descartes’ Meditations on First Philosophy*, p. 178-179 [↑](#footnote-ref-16)