Beyond Reinforcement: Deci (1971) on the Effects of Rewards on Self-Determination and Intrinsic Motivation

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Background to the Study

In 1971 Edward Deci published a seminal paper that challenged dominant conceptions of motivation and laid the foundations for what would become *self-determination theory* (SDT; Deci & Ryan, 1985; Ryan & Deci, 2017). At the time the paper was published, behaviourism dominated the field of psychology. Behaviourism of that era was focussed on the use of external reinforcers — contingent rewards and punishments — to control behaviour. The dominant view was that behaviour is a function of these external consequences, which make specific actions more or less probable. Drive theory (Hull, 1943; Spence, 1956) similarly focussed on reinforcers, but additionally included an account of the types of events that would be reinforcing — those that support physiological needs (food, water, sex, and freedom from pain). Behaviours that satisfy these physiological needs, and return the organism to equilibrium, will be reinforced. That is, the reduction in the drive serves as the reinforcer, strengthening the connection between behaviour and external stimuli. Although some recognized differential sensitivity to reinforcing properties in the environment (e.g., Gray, 1970), it was the rewarding and punishing properties external to the organism that were seen as shaping emitted responses.

Yet, behaviourist and drive theories were unable to account for the observation that behaviours such as play and exploration seemed to occur spontaneously, without external reinforcement. For curiosity-based and exploratory behaviours the reinforcement appeared to be inherent to the behaviour itself. The reward-contingent motivation documented by behaviourists

is referred to as extrinsic motivation, whereas behaviours that are enacted out of interest, enjoyment, or curiosity are considered to be intrinsically motivated.

Intrinsic motivation would later become a core component of self-determination theory (Ryan & Deci, 2017), which is a theory of human motivation and personality that highlights the importance of internal resources and needs for personality development and self-regulation. SDT distinguishes between different types of motivation that fall along a continuum from fully externally controlled to fully intrinsic motivated (Ryan & Deci, 2000). Importantly, one might engage in the same activity (e.g., reading a book) for either extrinsic (e.g., in order to receive a reward) or intrinsic (e.g., because the content is interesting) reasons. Motivation is therefore defined as the cause of or reason for goal pursuit, the *why* of behaviour (Deci & Ryan, 2000).

Within the SDT framework, intrinsically motivated behaviours are viewed as exemplifying humans' (and other organisms') inherent propensities for growth and knowledge acquisition. According to SDT, humans are not merely passive objects pushed around by outside forces (though they can be), but are agents operating on the environment and within relational contexts with innate propensity toward growth, self-regulation, and integration (Ryan & Deci, 2000). In order for these growth tendencies to be actualized, however, the organism must be provided with certain nutrients. These essential nutrients make up the *basic psychological needs* posited by self-determination theory: competence, autonomy, and relatedness. Competence refers to the feeling that one is effective in one's social interactions and has opportunities to exercise and develop one's capacities. Autonomy refers to the perception that one is the source or origin of one's own behaviour or that one is acting in accord with one's personal values and beliefs (Deci & Ryan, 1985). The third need, relatedness, is defined as the feeling of being connected to other individuals and one's community; it is the sense of caring for others and having them care

for you in return (Ryan, 1995). These three needs are *basic* in the sense that they are universal and essential to optimal functioning, growth, integration, social development, and well-being (Ryan & Deci, 2001). When these needs are not met, the organism suffers. Autonomy, competence, and relatedness are thus the psychological equivalents of the physical needs (e.g., food, water, sex) that arouse drive states (e.g., hunger, thirst, lust; Hull, 1943).

Today considerable evidence supports the view that the satisfaction of autonomy, competence, and relatedness affects the quality and persistence of behaviour. We also know that incentives (e.g., money), styles of feedback (e.g., praise, informational feedback), and social support (e.g., instrumental and emotional support) differentially affect motivation and performance at work, school, sports, and other domains as a function of how they impact these basic psychological needs. These basic psychological needs and their impact on the quality of motivation are, however, relatively new developments in psychology. Here we look back almost 50 years ago to a humble set of experiments that, although being far from definitive, set the stage for a new motivational science focussed not just on motivation due to external forces, but also on the motivation that comes from within people. These experiments emerged from a doctoral dissertation by Edward Deci, a social psychologist examining the impact of external rewards on intrinsic motivation.

The three experiments published by Deci in 1971 included two major contributions to the study of motivation. First, they introduced a method to assess intrinsic motivation in humans by behavioural means. This operational definition helped bring the concept of intrinsic motivation into the world of experimental social psychology, where previously the emphasis was much more on how individuals are shaped by being part of a social group. Second, these experiments purported to demonstrate that external rewards, when experienced as causing or controlling one's

behaviour, undermine intrinsic motivation (e.g., a person may feel that they are "being bought" by money). Feeling controlled, even by positive rewards, eroded a psychological satisfaction essential to intrinsic motivation — a sense of initiative and volition. Although such notions were previously discussed in terms of cognitive dissonance (Festinger, 1957), and even the effects of expectations of reward and punishment from a purely learning approach (see Chapter 7), these theories failed to provide an explanation of observed behavioural effects in terms of basic psychological needs. These findings opened a new direction for studies in human motivation by focussing on intrinsic motivation and the psychological need satisfactions required to sustain it. In addition, these studies laid the foundation for understanding both the positive and negative effects of external rewards on volitional behaviour —the implications of which are vast.

Behaviourism

In the 1960s the predominant model of behavioural regulation in mainstream psychology was *radical behaviourism*, which as we noted focussed on the control of behaviours through contingencies of reinforcement — human behaviour was modelled on that of the rat and pigeon. This was for good reason. Decades of experiments had reliably shown that, when carefully applied in controlled settings, external reinforcements could control (shape and sustain) specific behaviours (Skinner, 1953). The sophistication of this behavioural control technology appealed to many, not least of all the advertising industry.

Still there were rumblings of dissent within the field. Although behaviourists had clearly shown how behaviours *can* be controlled by external reinforcements, many researchers questioned whether *all* organized actions are, in natural environments, motivated by such contingencies — in addition, the most powerful demonstration of these effects were found in laboratory animals where psychological needs of any complexity are absent. In particular, there was the problem of *intrinsic motivation* — spontaneous behaviours that seem to occur out of

interest, curiosity, or playfulness, and no previous conditioning/learning. Many activities, even in rats, as well as primates and humans (i.e., the primary species targeted in experiments), such as exploration, play, and object manipulation, frequently occur without prior external (at least, explicit) reinforcements. Experiments even showed that animals would endure pain or forego primary reinforcers, such as food and water, for opportunities to explore or exercise their capacities (e.g., Nissen, 1930). Furthermore, as Harlow (1950) and Gately (1950) observed in primate studies, such "intrinsically motivated" activities could be disrupted rather than enhanced by the introduction of external rewards. It could always be asserted that, in some way, such behaviours were controlled by non-obvious prior exposure to reinforcement, but this approach fails to provide a satisfactory scientific explanation.

In a seminal paper, White (1959) famously summarized the failures of both drive theories (Hullian and psychoanalytic) and operant or "radical" behavioural theories to explain intrinsically motivated behaviours. White argued that, rather than being dependent on reinforcement, such activities were innate adaptive propensities and that they were proximally motivated by psychological needs, especially the need to impact or effect one's environment, which he termed *effectance motivation*. White's focus was on psychological or intrinsic satisfactions (rather than either drive reductions or external rewards) as the motivational basis for activities, such as play, exploration, curious learning, and other activities that engage and elaborate human capacities.

Building on White's (1959) idea of effectance motivation, as well as Heider's (1958) attribution theory of perceived causality, de Charms (1968) argued that a key psychological satisfaction underlying intrinsic motivation is that of being an *origin* of one's actions, or experiencing a sense of initiative and autonomy. Following Heider's (1958) terminology, de

Charms described this sense of behaviour originating from the self as having an *internal perceived locus of causality* (IPLOC). Opposite to perceiving oneself as the origin of one's behaviour is the feeling that one is a pawn whose actions are driven by forces outside of the self. Having an *external perceived locus of causality* (EPLOC) is thus the perception that factors external to the self are the cause of one's behaviour. De Charms (1968) further speculated that being extrinsically motivated (e.g., being motivated by grades or other rewards) should, by diminishing one's sense of being an origin and fostering an EPLOC, negatively impact intrinsic motivation.

As we shall see, Deci's (1971) experiments built on both of these theoretical foundations. In keeping with both White and de Charms, Deci suggested that whether rewards, feedback, and other events enhance or diminish intrinsic motivation will be a function of how they affect feelings of self-determination (being an origin) and competence (experiences of effectance). Financial rewards, because they readily foster an EPLOC, should diminish intrinsic motivation. Yet, when rewards support or encourage self-determination and competence, they should maintain or enhance intrinsic motivation. Verbal rewards and positive feedback were hypothesized to do just that.

Such proposals were at that time highly controversial. First, the consideration of any "inner" forces within an organism "causing" behaviours as implied by the construct of *intrinsic motivation* was, within at least some behaviourist circles, anathema. To many, this idea seemed reminiscent of Cartesian 'ghost in the machine' of *vitalist* philosophy. Beyond that, another contentious issue was the notion that an effective reinforcement could *decrease* subsequent behaviour relative to no external reinforcement. Several decades of systematic research had clearly established the power of reinforcements to control and sustain behaviour, at least while

contingencies remain in effect. It was recognized, of course, that any given stimulus might not function as an effective reinforcer and that withdrawal of reinforcement would lead to extinction of the previously reinforced behaviour. However, financial payments, or what Skinner described as that "universal generalized reinforcer, money" (p. 62), were posited to be an effective strategy for increasing or maintaining behaviours — of course, it may control immediate behaviour (receiving £10 each for each jump), but it would hardly lead to longer-term behaviour in the absence of such a reward (jumping would then become aversive). Yet the idea that such a reliable reinforcer might actually *undermine* subsequent motivation was for some scientifically problematic, if not downright heretical (e.g., see Scott, 1976).

Deci's 1971 and 1972 publications were important in part because they provided an empirical methodology for addressing an area of controversy within the field of behaviour regulation and motivation at the time. In these experiments, Deci specifically introduced an operational and behavioural definition for *intrinsic motivation* — the *free-choice behavioural paradigm*, an approach that became a standard in the field. Furthermore, these studies tested nascent ideas about the role of psychological needs in maintaining intrinsically motivated behaviours, as well as the varied effects of external factors such as rewards, praise, and evaluative feedback on intrinsic motivational processes.

Detailed Description of the Study

Differing predictions. Deci (1971) began with this question: If a monetary reward is offered for performing an activity one already finds interesting, what effect will this reward have on subsequent intrinsic motivation? At the time, existing literature offered differing predictions as to what should occur.

Operant psychology maintained (albeit using different language) that intrinsic and extrinsic motivation would be additive. Behaviour would increase when effective reinforcers (in this case financial rewards) were applied, and would return over time to pre-reward baseline after the reinforcement was removed (extinction). Expectancy-valence theories of motivation, which were prominent at this time within organizational psychology, similarly assumed that intrinsic and extrinsic motivation would have additive behavioural effect (e.g., see Porter & Lawler, 1968).

Counter to this, Deci (1971) anticipated that the motivational impact of rewards might depend on how they are experienced. Building on de Charms (1968), Deci reasoned that the application of contingent extrinsic rewards to an intrinsically motivated activity could prompt a change in the *perceived locus of causality* from internal (IPLOC) to external (EPLOC). Although participants would have initially been doing the activity because it was interesting and challenging (i.e., for internal reasons), those in reward conditions may come to view the activity as something done in order to obtain an externally controlled reward. In other words, offering rewards would shift participants' perceived locus of causality from internal to external, undermining their experience of being an origin, and thus their intrinsic motivation. In behavioural terms, Deci hypothesized that rewarding participants for engaging in interesting activities would cause performance of that behaviour to drop below baseline levels, rather than simply returning to baseline, once these incentives were removed. Alternatively, Deci reasoned that rewards that did not interfere with participants' experiences of "self-determination and competence" should not produce this undermining effect on subsequent intrinsic motivation.

Deci's primary measure of intrinsic motivation was what he called the *free-choice behavioural paradigm,* a strategy upon which most subsequent experimental work on intrinsic

motivation has been based. In this approach, intrinsic motivation is operationalized as the amount of time participants spend engaged with a target activity when they are alone, are not being observed, are free to choose what to do, have alternative activities available, and have no explicit incentives for continuing on the target task.

Experiment 1. Deci (1971) had two groups of participants work on interesting spatial puzzles over three sessions, each separated by at least one day. The task was called a SOMA puzzle, the goal of which is to assemble a set of three-dimensional shapes such that they match various depicted figures, with some figures more difficult to construct than others. In the initial experimental session, both groups worked on these puzzles without mention of incentive or reward. To assess baseline intrinsic motivation, Deci assessed free-choice behaviour during an 8-minute break in the middle of this initial session. After administering a few puzzles the experimenter left the room under the pretext of selecting additional materials. Participants were told they could continue to do puzzles, read magazines, or do whatever they chose while they waited for the experimenter to return. The room contained magazines and alternative activities, as well as more of the spatial puzzles. Participants were surreptitiously observed during this time and the number of seconds they spent on the target activity — that is, working on these spatial puzzles — was recorded.

In a second session, participants in the experimental group were offered rewards for completing these puzzles ($1 for each puzzle solved — remember it's 1970!), whereas the control group continued to work on these puzzles without knowledge or expectation of a reward. Finally, in a third session, participants in the experimental condition were told that unfortunately the budget was not enough to pay them for more than one session. Therefore, both groups participated in the final session without expecting any reward. As in the initial session, this third

session included a free-choice period in the middle where participants could occupy themselves as they pleased, presumably unobserved.

The question of interest was what effect receiving rewards for performing the puzzle task in session 2 would have on intrinsic motivation for the task, operationalized as a change in the time spent working on the puzzle task during session 1 (baseline) and session 3's free-choice periods. If rewards undermined the IPLOC for doing the puzzle task, rewarded participants should show a greater decrease in this behaviour during the final free-choice period compared to those who had never received rewards for this activity.

By any modern view this initial study was quite statistically underpowered — and with only 24 participants, the effects of this first study were only marginally significant. Nonetheless these results were provocative in suggesting a potential negative effect of rewards on post-reward persistence, an outcome not previously observed in experiments with humans. Specifically, participants who had received extrinsic rewards for solving these interesting puzzles spent much less time working on the puzzles during the final free-choice period than they had in the initial one (before incentives were introduced). Those who never received rewards for completing these puzzles evidenced a smaller decrease in time spent working on the puzzles between the first and last free-choice periods. These results were interpreted by Deci to represent the undermining of intrinsic motivation by the financial rewards — participants who had been rewarded were now less interested in the task than those who had not been.

Experiment 2. Deci's second 1971 study was a field experiment conducted at a college newspaper office. The experiment utilized the newspaper's staffing structure, which had two four-person teams of headline writers whose schedules did not overlap. After four weeks of normal work (period 1, baseline), one of these teams was given $0.50 for each headline they

wrote, a contingency that continued for 3 weeks (period 2). The other (control) group did not receive and did know about any rewards. After being paid for these three weeks, the experimental group was told that funds for payment had been exhausted and that they could no longer be paid. Both groups were then observed over the final three-week period (time 3), as well as during the first two weeks of the following semester (period 4, follow-up), which began 5 weeks later. During each of these periods the time taken to write each headline was surreptitiously recorded by the experimenter, whom both teams believed to be a supervisor. This was used to index intrinsic motivation based on the assumption that faster work (better performance) is indicative of higher intrinsic motivation. The number of times team members were absent was also assessed.

On the performance measure the primary hypothesis was supported. Whereas the unrewarded group continued to become more efficient (faster) in headline writing, the reward group showed little increase in efficiency after rewards were withdrawn. The experimental group also showed a trend toward increased absenteeism after the reward period relative to controls. Both findings were interpreted to indicate a relative decrease in intrinsic motivation in the reward group.

Experiment 3. Study 3 in this series was almost identical to the first in design. This time, however, Deci used "verbal rewards" (praise and positive feedback) rather than financial rewards as the experimental manipulation. Verbal rewards can, of course, take many forms. For example, such rewards might involve telling people that they did well at a task, that they have shown great effort, or that they outperformed others. In study 3, participants in the verbal rewards condition received feedback such as: "You did very well in completing the task; many participants did not complete it." If they failed to complete a puzzle they were told: "This was a very difficult one,

and you were progressing very well with it." These forms of verbal rewards were specifically chosen, as they are likely to support supporting feelings of competence and efficacy. Deci hypothesized that verbal rewards like these would typically not be experienced as controlling, but rather as "encouragement." Therefore, unlike contingent financial rewards, this type of verbal reward would be unlikely to create an EPLOC or undermine intrinsic motivation.

As expected, results showed no undermining effect of these verbal rewards on intrinsic motivation. Whereas intrinsic motivation in the control group declined over sessions, that of the experimental group was maintained. Yet, as with the previous two experiments, small sample size, baseline differences in intrinsic motivation between groups, and even some apparent subgroup differences (arts versus technical students) suggest that effects obtained may be readily moderated, if not unreliable. Nonetheless, the interpretation drawn from these three studies was that receiving an external reward for doing an activity can, under some circumstances, lead to a loss of intrinsic motivation. In contrast, positive feedback can maintain or increase intrinsic motivation.

It is important to note that the detrimental and facilitating effects of specific types of rewards in these early experiments concerned people's *subsequent* motivation—after rewards are removed. There was no argument from Deci as to whether rewards, when salient and potent, could motivate *immediate* behaviour. Thus, the scientific problem here was specifically the impact of rewards on the maintenance of intrinsically motivated behaviour, after rewards had been removed. What Deci purported to demonstrate was that a reward, when experienced as the external cause of one's behaviour, could undermine subsequent persistence by taking away some of the psychological satisfactions that had been there—specifically here the sense of being an origin, which de Charms had argued was essential to intrinsic motivation.

Deci's (1971) experiments were published nearly simultaneously with a set of related experiments intended to clarify these novel, yet somewhat shaky findings, as well as to resolve a few of the more obvious experimental limitations. Thus Deci (1972a, 1972b) altered the within-person free-choice paradigm. In the 1971 experiments participants came for three separate sessions, each a day apart, with the key comparison being session 1 versus session 3 free-choice behaviour. In the 1972 studies Deci employed a simpler approach that he called the *general one session paradigm* (Deci, 1975). In this procedure participants are randomly assigned to work under various conditions (e.g., contingent vs. non-contingent rewards, verbal vs. tangible rewards, etc.). Immediately following the experimental session they are assessed for intrinsic motivation using a free-choice behaviour period. Based on randomization assumptions, hypothesis testing then focusses on between-condition differences on this "post-only" free-choice persistence measure. Using this simpler paradigm, the initial 1971 findings demonstrating the undermining effect were supported and extended. These studies again provided evidence that financial rewards could undermine free-choice behaviour relative to no rewards, and that, at least for males, verbal rewards seemed to enhance intrinsic motivation.

Deci also examined the effects of monetary rewards that were not contingent on specific engagement with the activity or successful completion of it. Thus, whereas in the initial 1971 experiments participants were given a financial reward for each task correctly completed, in this second series some were paid simply for showing up for the experiment. Here rewards were not expected to foster an EPLOC as they are not really controlling task activity. Indeed, results indicated that this type of financial reward did not decrease intrinsic motivation, highlighting the idea that the influence of rewards depends on how they impact people's perceptions of the source of their behaviour. Only rewards that foster an EPLOC undermine intrinsic motivation.

Based on these early experiments (Deci 1971, 1972a 1972b), Deci introduced a tentative *cognitive evaluation theory* (CET) to account for his varied results. He argued that there are at least two aspects to any external reward, a "controlling" aspect and an "informational" aspect. The controlling aspect leads to a decrease in intrinsic motivation by changing the perceived locus of causality from internal to external. The informational aspect leads to an increase in intrinsic motivation by increasing the person's sense of "competence and self-determination." For example, whereas money given as an external reward for task completion is salient as a control and readily fosters an EPLOC, verbal rewards (positive competence feedback) tend to be interpreted as informational, and support feelings of "self-determination and competence" essential to intrinsic motivation.

Impact of the Study

Well beyond the specific issue of rewards, Deci's 1971 paper opened the door to what has become a vigorous field of experimentation on intrinsically motivated behaviours. By looking at the effects of external factors on free-choice behaviour as mediated by various psychological need satisfactions or frustrations, new understandings of intrinsic motivation and strategies for catalyzing or sustaining it have emerged. These models, and the interventions based on them, show reliable pathways toward enhancing people's quality of engagement and performance.

Deci's (1971) work also suggested that rewards could shift people's perceived locus of causality, diminishing their sense of "self-determination and competence." The implications of these early CET findings turned out, however, to be even broader than just intrinsic motivation. Indeed, perceptions of autonomy and competence impact the quality of extrinsic as well as intrinsic motivation. In fact, the primary distinction within SDT, accounting for substantial

variance in the outcomes of studies in occupational contexts, as well as across domains, is the distinction between *autonomous motivation* and *controlled motivation* (e.g., Deci & Ryan, 2000; Ryan & Deci, 2017), into which these early experiments had only begun to tap.

Deci's 1971 classic studies also planted the seed of what has become a broad and general organismic theory of human motivation, namely self-determination theory (Deci & Ryan, 1985; Ryan & Deci, 2017). CET is now but one of six mini-theories within the broader framework of SDT, which deals with the impact of psychological needs for autonomy, competence, and relatedness on motivation, development, and well-being (Ryan & Deci, 2017). CET posits that experiences of autonomy and competence were essential to intrinsic motivation. Subsequent work has gone on to show how autonomy, competence, and a third need for relatedness are all essential to the process of internalizing extrinsic motivation and becoming autonomous for behaviours that are not in themselves intrinsically motivating. Moreover, research has continuously shown that the very same need satisfactions that support intrinsic motivation and internalization are also critical factors in determining well-being across the lifespan. SDT research has taken these formulations into nearly every practical domain, including work, sports, healthcare, behaviour change, education, and even virtual worlds. In each domain both growth and wellness have been shown to be largely a function of these psychological need dynamics, resulting in a strong evidence base for clinical trials and interventions.

Critique of the Study

Looking back on these early experiments one can find much to criticize from a methodological standpoint. Most outstanding is that all three of the 1971 studies are statistically underpowered--or carried out with very small samples: This meant it was difficult to detect an experimental effect where it existed (Type II error). Due in part to these small sample sizes,

many findings do not reach an acceptable level of inferential statistical significance; several findings are trends or significant but with weak effects. In some of these studies, specific condition effects occur that are clearly not what was predicted. For example, in one study Deci (1972b) men's, but not women's, intrinsic motivation was enhanced by verbal rewards. There is considerable discussion in each article of post-hoc interpretations of these unanticipated effects. Another issue stems from the within-person design used in studies 1 and 3 of the 1971 paper, which took place over three separate sessions, and used a free-choice period collected in the middle of each session. That initial design entailed much statistical noise, such as differing means at baseline in intrinsic motivation, or unpredicted variations over time. It is also unclear the extent to which a free-choice period in the middle of an experiment is truly apt, as participants may still think they need to perform. Some of these problems were improved by developing the "post-only" experimental design used in 1972a and 1972b. Finally, yet another weakness is one common to much research from this era in experimental social psychology—the research was exclusively based on a relatively homogenous group of northeastern U.S. university students.

Despite these many flaws, collectively these early behavioural studies of intrinsic motivation conveyed a strong and new message: the effect of external rewards on intrinsic motivation could vary as a function of how those rewards are interpreted by participants. Experiences of self-determination (IPLOC) and competence (effectiveness) were important predictors, indeed, there were mediators of these outcomes. All of these features would become core principles in later theorizing and empirical models, especially within self-determination theory (SDT; Deci & Ryan, 1985; Ryan & Deci, 2017). Yet in 1972, these findings stood merely as initial evidence supporting a new approach to thinking about motivation.

Reactions and Subsequent Findings

Given both the controversial nature of these claims and the methodological issues of these studies, it is not surprising that in the short term a number of behaviourists made varied attempts to attribute these findings to methodological flaws or biases (e.g., see Calder & Staw, 1975; Scott, 1976). With time, however, other investigators began to replicate the undermining effect of rewards on intrinsic motivation using different tasks, different rewards and reward contingencies, and different age groups. For example, Lepper, Greene and Nisbett (1973) provided school children with materials to engage in a drawing task expected to be intrinsically motivating. Some were given an extra incentive: they were told that they would receive a "good player award" if they did the drawing. Others did the same activity with no mention of an award. In a free-choice period held days later, children who had received the award spent significantly less time engaged with the drawing materials than children in the no-award group, replicating the undermining effect.

By 1980, there was substantial experimental evidence of the undermining effect stemming from the use of the free-choice behavioural paradigm. Deci and Ryan (1980) reviewed this literature and formalized *Cognitive Evaluation Theory* (CET; Deci & Ryan, 1980), which represented the first of what are now the six mini-theories of *self-determination theory* (Deci & Ryan, 2000; Ryan & Deci, 2017). CET argues that intrinsic motivation is supported and maintained by the satisfaction of basic psychological needs. These include the needs for autonomy and competence. The impact of rewards on intrinsic motivation depends upon how the reward affects these satisfactions. Rewards can have a negative impact on autonomy by creating an external perceived locus of causality for engaging in an activity. They can also impact competence, either supporting a sense of effectance (White, 1959), or contributing to a sense of

incompetence. Thus, the effects of rewards and feedback are a function of their controlling (autonomy relevant) or informational (competence relevant) aspects.

Further Developments

These early experiments were important in opening up systematic research on the effects of different reward contingencies on intrinsic motivation. Ryan, Mims, and Koestner (1983) developed a taxonomy of reward types based on CET, to specify which types of reward structures would undermine intrinsic motivation and which would maintain or even enhance it. The taxonomy was accompanied by experimental data using the free-choice behavioural paradigm, and post-only design introduced by Deci (1972b). Results demonstrated support for the central tenets of CET. Specifically, when external rewards were used to motivate either task engagement or performance they ran significantly greater risk of undermining free-choice behaviour than when non-contingent or no rewards were employed. These results also indicated that verbal rewards could be delivered in informational or controlling ways, with only the former enhancing intrinsic motivation. In line with Deci (1971), the more salient the controlling aspects of rewards are, the greater their undermining effect on intrinsic motivation will be.

The Current Status of Research on the "Undermining Effect"

Research on CET and the undermining effect continue, as does much research on the motivational effects of rewards from other theoretical perspectives. There have been a number of meta-analyses of this impressively large research field, all but one of which supported CET. However, in the mid-nineties, the *American Psychologist* published a heavily disputed meta-analysis (see Ryan & Deci, 1996) that claimed to show that the undermining effect of rewards on intrinsic motivation was a "myth" (Eisenberger & Cameron, 1996). Given both the suspected problems with this meta-analysis, and the high profile of this venue, a reanalysis of these data,

and an even more detailed meta-analysis, was presented by Deci, Koestner, and Ryan (1999). This new meta-analysis specifically documented the mistaken numerical values and miscategorized entries that were the basis of Cameron and Eisenberger's finding of a "null" effect for rewards on intrinsic motivation. Aggregating over a hundred experimental studies, results instead showed robust support for all the major predictions of CET, including those from Deci's 1971 and 1972 papers, as well SDT's reward taxonomy (Ryan et al., 1983). Meta-analytic results indicated that the effects of rewards varied systematically: contingencies likely to foster an EPLOC (e.g., task-contingent, tangible rewards) were more undermining of intrinsic motivation than non-controlling rewards (e.g., unexpected rewards; verbal rewards). Although invited, there were no significant challenges to the findings of this reanalysis (e.g., see Eisenberger, Pierce & Cameron, 1999) leaving CET's organization of results the standard point of reference for understanding these effects.

Recent Examples of the Undermining Effect

The undermining effect as studied by Deci 1971 was focussed on intrinsic motivation for solving a puzzle—largely a cognitive challenge. But as understanding of intrinsic motivational processes has expanded so too have the domains in which CET principles have been applied. Here we provide a few examples illustrating the currency of this paradigm and its important predictions regarding a range of phenomena.

Prosocial behaviours

Developmental evolutionary researchers Warnaken and Tomesello posit that some prosocial behaviours, such as the propensity to help others, might be intrinsically motivated. To show this, they first had to establish evidence of a strong and early spontaneous interest in

helping, and second, that this seemingly natural propensity could be undermined, rather than enhanced, by external rewards.

In one study from their research program, Warneken and Tomasello (2008) observed that toddlers (average age 20-month) in a laboratory setting attempted to help other adults at a very high rate. Nearly 90% of the time when they saw something dropped, or something out of the adult's reach, they attempted to aid the adult. But was such helping intrinsically motivated?

To test this hypothesis, Warneken and Tomasello contrasted three conditions. In the first, when children helped, the adult simply did not respond. In a second, when the toddler helped, he or she was praised, but in a non-controlling way ("thank you, that's really nice"). In a third condition, the child was given a reward for helping (a cube which operated a jingle toy), with the adult saying: "for this, you get a cube." The cube was pre-established to be desirable to the children, who knew how it operated. This third condition thus represents a type of reward contingency that, according to CET, should foster an EPLOC. Because this desirable, but contingent reward makes salient the external control it should therefore undermine intrinsic motivation for helping, if such intrinsic motivation exists.

Subsequently, children were invited to return to the laboratory for what was essentially a "free-choice period," in which they could spontaneously help, or not. Warneken and Tomasello's findings confirmed a pattern similar to that expected in Deci (1971), but this time for toddlers' helping behaviours. Children given rewards for helping were subsequently *less* likely to engage in helping behaviours than those in either of the other conditions. Contingent positive rewards had undermined the intrinsic motivation that otherwise was present for doing good (see also Weinstein & Ryan, 2010).

Eat your vegetables

Motivating children to eat healthy foods is not always an easy task. In an intriguing experiment Dominguez et al. (2013) applied CET to motivating 4-6 year old children to eat vegetables. Recall that CET argues that an IPLOC, or sense of volition, enhances intrinsic motivation. Experiments within CET have shown in fact that having choice in one's activity can enhance an IPLOC, as it supports that sense of autonomy or volition (Patell, Cooper & Robinson, 2008). Thus, Dominguez and her colleagues created conditions under which children had choice or no choice regarding which vegetable they consumed, using vegetables that had been similarly rated at pre-test. Results showed that children in the two conditions where choice was offered consumed more vegetables than those in the no choice condition. This finding was interpreted to indicate that the choice conditions enhanced children's IPLOC, or autonomy, for the behaviour and that this, in turn, increased the children's intrinsic motivation for eating vegetables.

A neuroscience illustration

Researchers have begun to examine how intrinsic motivation and its undermining by external rewards is manifested in neurophysiological processes (Di Domenico & Ryan, 2017). Among these new experiments we select and describe one that is close in spirit to the Deci (1971) studies.

Murayama, Matsumoto, Izuma and Matsumoto (2010) did an experiment in which Japanese participants worked on an interesting activity inside an fMRI. If you have ever been inside an fMRI magnet, you might expect that it is not easy to find something fun to do in that setting! However, Murayama and colleagues introduced a reaction-time game using a virtual stopwatch that participants found enjoyable. Participants completed two experimental sessions each of which included task trials completed within the fMRI as well as a free-choice period outside of the scanner during which participants could choose to continue to play the stopwatch

game. Participants received feedback about whether they succeeded or failed on each trial completed during the fMRI portion of each session. During session 1 half of the participants were randomly assigned to a reward condition in which they were told they could expect performance-contingent monetary rewards for successful responses. The other half of participants received instead a comparable, but unexpected, reward upon completing the fMRI trials. Such unexpected task-noncontingent rewards had previously been shown not to yield an undermining effect (Ryan et al., 1983; Deci et al., 1999). All participants then completed a free-choice period. In the second experimental session, all participants were informed that no performance-based rewards would be offered and again completed the stopwatch task in the fMRI as well as a final free-choice period. Of interest, first, was whether participants who received performance-contingent rewards would show the undermining effect during the two free-choice periods that followed. Second, and most important to this study, was whether patterns of brain activity would differ for participants who received performance-contingent rewards (and evidenced an undermining effect on intrinsic motivation) compared to those did not receive performance-contingent rewards.

Results indicated that participants who received performance-contingent rewards evidenced significantly less free-choice activity during free-choice periods relative to those who received the unexpected, non-contingent reward. Findings further showed significant differences in brain activity for the participants receiving expected versus unexpected rewards. Targeted analyses focussed on striatal activation and midbrain activity, as these areas are part of the neural "reward network." Notably, both groups showed greater bilateral anterior striatum and midbrain activity when they succeeded versus failed, regardless of reward condition, illustrating the internally rewarding effects of competence feedback. Further, in the first session, when one

group of participants was working to get rewards and one was not, the reward group showed significantly greater bilateral striatum activation and midbrain activity than did the no-reward group, indicating that the reward was working to activate the reward network. Yet, it bears emphasis that both groups showed significant activation, indicating that this enjoyable and challenging task was "rewarding" even for those not receiving external rewards.

Most important for our discussion, however, are findings from the second session, when expected rewards were removed. Results revealed significantly *less* reward-network activation in participants who had been in expected-reward condition compared with those in the unexpected-reward condition. Expected and contingent rewards resulted in decreased activity in the anterior striatum and midbrain once these rewards were no longer offered. Parallel results emerged for another region of interest — the right lateral prefrontal cortex. These findings suggested that the expected reward group was less cognitively engaged post-rewards than those who had received unexpected rewards. As well, levels of activity in the three regions (i.e., anterior striatum, midbrain, and right prefrontal cortex) were correlated with each other, and participants who evidenced lower levels of activation in these three regions during this second session, spent less of the free-choice period engaging with the target activity.

Although a relatively new area of research, studies of the neural patterns associated with the motivational dynamics specified in CET are rapidly emerging. These studies highlight that the phenomenological distinctions made within SDT have reliable correspondence to activation in expected brain regions (Di Domenico & Ryan, 2017). Indeed, this interface holds great promise for deepening our understanding not only of the undermining effect of rewards, but also of other phenomena encompassed by SDT.

Conclusions

It is interesting to note that today this "classic" paper from Deci 1971, with its small samples and relatively shaky findings, would very likely not be published, and certainly not in the field's top journal. It was not the strength of its data that made this report noteworthy in its time, or explains why it remains such a highly cited classic today. Rather, the impact of this paper is due to its introduction of a new behavioural method of assessing intrinsic motivation, the free-choice period, along with new theoretical ideas about how that important type of human motivation can be understood. Instead of attempting to control behavior using rewards, Deci was instead looking for facilitation or undermining effects on a form of motivation he assumed was already there. These early studies thus provided a new direction for motivation research and planted a seed that later became self-determination theory (Deci & Ryan, 1985; Ryan and Deci, 2017), an approach to learning, development, and wellness that has generated effective frameworks for research and practice that continue to go beyond reinforcement.

Further Reading

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