



## Changing healthcare professionals' non-reflective processes to improve the quality of care

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### ABSTRACT

**Rationale:** Translating research evidence into clinical practice to improve care involves healthcare professionals adopting new behaviours and changing or stopping their existing behaviours. However, changing healthcare professional behaviour can be difficult, particularly when it involves changing repetitive, ingrained ways of providing care. There is an increasing focus on understanding healthcare professional behaviour in terms of non-reflective processes, such as habits and routines, in addition to the more often studied deliberative processes. Theories of habit and routine provide two complementary lenses for understanding healthcare professional behaviour, although to date, each perspective has only been applied in isolation.

**Objectives:** To combine theories of habit and routine to generate a broader understanding of healthcare professional behaviour and how it might be changed.

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**Methods:** Sixteen experts met for a two-day multidisciplinary workshop on how to advance implementation science by developing greater understanding of non-reflective processes.

**Results:** From a psychological perspective ‘habit’ is understood as a process that maintains ingrained behaviour through a learned link between contextual cues and behaviours that have become associated with those cues. Theories of habit are useful for understanding the individual’s role in developing and maintaining specific ways of working. Theories of routine add to this perspective by describing how clinical practices are formed, adapted, reinforced and discontinued in and through interactions with colleagues, systems and organisational procedures. We suggest a selection of theory-based strategies to advance understanding of healthcare professionals’ habits and routines and how to change them.

**Conclusion:** Combining theories of habit and routines has the potential to advance implementation science by providing a fuller understanding of the range of factors, operating at multiple levels of analysis, which can impact on the behaviours of healthcare professionals, and so quality of care provision.

### List of abbreviations

HCP	Healthcare professional
NET	The Novice to Expert Theory
IM	Implementation Mapping
NoMAD	The Normalization Measure Development questionnaire
NPT	The Normalization Process Theory

## 1. Background

The process of translating medical innovations into clinical practice is often slow and costly, which means that patients do not always receive the best possible care (Grimshaw et al., 2012). In addition, a substantial amount of care delivered is ineffective, outdated and potentially harmful (Grimshaw et al., 2020). Evidence-based guidance aims to improve health and social care practices, but research shows that healthcare professionals (HCPs) do not always adhere to such advice (Fischer et al., 2016). HCPs can be defined as the people who are involved in delivering healthcare and services to those with chronic or acute conditions, such as doctors, nurses and allied health professionals. This definition also includes professionals working in preventive medicine, public health and community health. Recognising that provision of evidence-based care requires HCP behaviour change, a substantial amount of work within the field of implementation science draws on behavioural, organisational and sociological approaches to support HCP behaviour change.

To date, behavioural theories applied in implementation science have tended to overly focus on the reflective processes (e.g., intention) that influence HCP behaviours such as prescribing, examining, advising and the use of guidelines more broadly (Godin et al., 2008). Despite their proven utility in explaining HCP behaviour, theories focusing exclusively on reflective processes have been criticised for not sufficiently accounting for the impact of non-reflective processes, such as habits, on behaviour (Sheeran et al., 2013). We define non-reflective processes as those factors that bypass conscious deliberation and so generate actions fast, effortlessly and with little deliberation and awareness. Evidence suggests that between 30 and 50% of people’s everyday behaviours are repetitive and performed in the same physical location (Wood et al., 2002). Neuroimaging studies have shown that non-reflective processes are represented as neural networks that ‘remember’ recurring contexts, including efficient responses to those contexts, which are prompted when we encounter them (Heatherton and Wagner, 2011). Although much of the literature on non-reflective processes in real-world settings relates to behaviours of patients and the public, evidence is starting to emerge demonstrating the role of non-reflective processes in relation to HCP behaviour (Presseau et al., 2014).

Different disciplines have a particular lens on this area of research, but ‘silo thinking’ - approaching the problem from a single perspective - is an impediment to translating theory into application, therefore an interdisciplinary approach is required. To move the field forward, we need to develop a better understanding of different models of non-reflective processes, their mediating and moderating factors and identify potential strategies for capitalising or addressing them. In this article we focus on combining two complementary non-reflective processes (i.e., habits and routines) to advance our understanding of HCP behaviour change. We focus specifically on habits and routines because they are the two dominant theoretical approaches to non-reflective HCP behaviour.

From a psychological perspective, habit is defined as a process whereby internal and contextual cues trigger automatic reactions based on a learned cue-response association (Gardner, 2015). A habit perspective can help us to understand how specific practices are maintained due to repetition of a behaviour in a specific setting. Once an action has become habitual, it becomes regulated by non-reflective processes that place minimal burden on conscious (attentional or memory) resources, freeing up cognitive capacity to allow HCPs to focus on other tasks concurrently (e.g., talking to a patient whilst carrying out a physical examination).

Within the organisational literature, the term routine is used to describe “repetitive, recognisable patterns of interdependent actions, carried out by multiple actors” (Pentland et al., 2010 p. 95). For example, the management of acute stroke care patients in the emergency department involves multiple HCPs working together in a highly standardised way to minimise harm to the patient. ‘Routine’ is therefore a broader concept than habit; whereas habit denotes an individual-level process, based on person-specific learned associations that cue specific behaviours, routines can be sustained by multiple actions, occurring at multiple levels, involving multiple actors. Routines can include reflective behaviours, but are generally non-reflective, due to their repetitive and context bound nature. The broader, organisational perspective invited by literature on routines offers a complementary lens by emphasising the importance of colleagues, systems and organisational procedures.

Given recent calls from the literature to apply theories of habit (Nilsen et al., 2012) and routine (Greenhalgh, 2008; Nilsen et al., 2022) to implementation science research, this article aims to: a) provide an overview of the characteristics of habitual and routine clinical behaviour; b) discuss possible theory-based factors that impact on habitual and routine clinical behaviour; c) take stock of a selection of intervention strategies for changing (i.e. creating and disrupting) habitual and routine clinical behaviour; and, d) recommend future directions for how to further investigate and evaluate habits and routines in this context.

This article is the result of a two-day international expert meeting on how to advance implementation science by considering non-reflective processes. Sixteen interdisciplinary leading researchers from nine countries joined the expert meeting to review and combine relevant theoretical perspectives. Participants included researchers from the fields of health psychology, medical sociology, health economics and implementation science.

## 2. Defining habitual clinical behaviour

Although there are various definitions of habit, the term is most commonly used to describe a cognitive process that *determines* behaviour, rather than a behaviour itself (Gardner, 2015). Habit forms through repetition of a behaviour in a specific setting until a mental cue-behaviour association becomes sufficiently strong that, upon exposure to the situational cue(s), an unconscious impulse to act is subsequently activated (Lally et al., 2010). Once this association has formed, the situation acquires the potential to initiate behaviour with little awareness, conscious control, cognitive effort or deliberation (Bargh et al., 1996). In other words, a habit is a memory-based cognitive structure, and habitual behaviour is a potential consequence of this structure. For example, for an experienced dentist, taking a dental radiograph may be a habitual behaviour that is initiated by a patient presenting with dental disease or a history of decay (Eccles et al., 2012). When habit triggers the onset of action, this is referred to as habitual instigation (Gardner et al., 2016). Habit can, however also influence behaviour by facilitating performance of the subsequent course of action (habitual execution) (Gardner et al., 2016). For example, once a patient has put on the leaded apron, then the dentist may automatically proceed through a ‘cascade’ of ‘smaller’ acts, with completion of each act habitually triggering the next (e.g., positioning of the X-ray machine alongside the patient’s head followed by pressing of record button). A systematic review and meta-analysis of nine studies involving 1975 HCPs found a medium-size combined effect of  $r^+ = 0.35$  for the association between habit and twelve different HCP behaviours, including prescribing, advising, and examining practices (Potthoff et al., 2019). In all included studies habit was measured via self-reports on the experience of automaticity with which the behaviour was generated (Orbell and Verplanken, 2015).

The idea that both reflective and non-reflective processes are relevant across HCPs’ behaviours and context is consistent with contemporary dual process models (Deutsch and Strack, 2008). According to dual process models there are two processes that work in parallel that influence human behaviour. The first is the *non-reflective process*, which is characterised as fast, effortless, and automatic; and the second is the *reflective process*, which is slow, effortful, and deliberate. The non-reflective is always active and continuously guides behaviour, whereas the reflective process may be engaged or disengaged depending on the circumstances (Deutsch and Strack, 2008). For example, during an annual diabetes check-up, a skilled HCP may be able to carry out a person’s diabetic foot risk assessment without thinking, so removing the need to engage the reflective process (non-reflective response) (Presseau et al., 2014). However, if the assessment shows that the person with diabetes has developed a foot ulcer, then the HCP may have to make some more deliberate decisions on whether to refer the person to specialist services (reflective response).

Theories of habit emphasise the intra-individual processes that maintain ingrained behaviour patterns in a consistent setting, such as the same clinical context. As such, they provide useful accounts of the influence of non-reflective processes on HCP behaviour. However, HCPs often work collaboratively in teams, within organisations, that have rules and norms that impact their work and it is therefore important to consider the context in which they work. The organisational and sociological literature thus offers a broader perspective that helps to better understand and describe how individual level actions are embedded in the overall structure of an organisation.

## 3. Defining routine clinical behaviour

Research on routines examines how multiple actions are connected in networks of functional events (Pentland and Feldman, 2007). Organisational routines are formed as teams create new connections and develop a shared understanding of systems and procedures to achieve common organisational tasks. For example, a ‘code blue’ is the term

used by medical institutions to signal that a patient is having a cardio-pulmonary arrest and requires immediate resuscitation. This resuscitation consists of a collection of highly routinised behaviours (e.g., calling for help, beginning CPR, obtaining crash car/defibrillator) that are carried out through collaborative work by a multidisciplinary ‘code team’ (including a nurse, physician, pharmacist, respiratory therapist and others). Patient survival and positive outcomes depend on rapid assessment of the situation and initiation of basic and advanced life support measures. All routines must have a strong tendency (i.e., repetitive patterns of actions), which makes them recognisable; however, rather than seeing those tendencies as fixed sequences, recent work has highlighted the flexibility with which routines can be performed (Pentland, 2003). Definitions of organisational routines as stable sequences of action do not define the underlying causal cognitive mechanisms. However, while some routines may involve reflective behaviours, it can be assumed that most organisational routines comprise of non-reflective behaviours. For example, due to the repetitive, context bound nature of actions such as conducting patient check-ups, physical, and health screenings, these routines will consist of non-reflective behaviours. However, subsequent referral to specialised services may be more cognitively taxing and may therefore entail reflective behaviours. While the reflective routine behaviours have been investigated in depth, the focus in this article is on the non-reflective routine behaviours and the transition from reflective to non-reflective behaviours.

A routine approach is congruent with sociological theories of practice that assume that no action can be traced back to a single source; this rules out the exclusive focus on individual decision-making that characterises many psychological approaches (Kuutti and Bannon, 2014). Routine approaches also chime with ethnomethodological work, sometimes referred to as workplace studies, that typically focus on collaborative work in with and around tools and technologies (Luff et al., 2000). According to practice theory, there is no clear separation between individual actors and the situation and setting affecting their actions (Bourdieu, 1977). Rather, practices – i.e., that which the psychologist may identify as ‘behaviours’ – are seen to be the product of complex dynamic interactions between various actors who draw upon a situation and historically evolving understanding of how they should act. For example, working in an operating team has been described as an apprenticeship whereby new members of the team learn to read the embodied human behaviours that are required for the practical production of anaesthetic work (Hindmarsh and Pilnick, 2002).

Actions such as lifting a mask or releasing a gas valve within a particular setting are used by apprentices to learn specific trajectories and therefore give them a sense of what will happen next in a collaborative working environment. Social practice researchers do not ask whether an individual has a habit that drives behaviour, or how we can support individuals with disrupting a habit. Unlike psychological approaches, social practice perspectives do not prioritise the individual performing a given behaviour; rather, their focus centres on the practice itself. Social practice researchers seek to map the socio-historical trajectories of collections of practices and the ways in which their enactment can become ingrained as a routine aspect of the everyday social world (Hui et al., 2016; Maniatopoulos et al., 2015). Practices can influence routines, but practices are more complex in that they incorporate complex meanings and associations, whereas routines are made up of coordinated patterns of action.

## 4. Combining theories of habit and routine

In this paper, we combine theories of habit and routine, so as to exploit the strengths of habit theory for quantifying and predicting the influence of non-reflective processes on specific HCP behaviours, and emphasise and harness aspects of routine theories that allow for interpreting and explaining how non-reflective processes may impact on multiple interrelated behaviours often carried out by teams of HCPs.

Theories of habit can help explain how frequent behaviour is sustained through a learned association between social and contextual cues in the clinical setting. Psychological dual process models explain how reflective and non-reflective processes can drive the behaviours of HCPs and what strategies are useful for modifying the two processes respectively. Importantly, habit theory provides explanations for ingrained clinical behaviours at a granular level by considering intra-individual psychological factors that drive behaviour. A routine perspective provides insights into how sets of practices and the way in which their coordinated performance can become established (or derailed) as a routine aspect of care provision. From this perspective, change can be achieved by mapping the dynamic relationship between different practices and changing the normative understandings of what constitutes an appropriate way of providing care.

Despite their unique contributions to explaining HCP behaviour, there is overlap between the habit and the routine concept (see Fig. 1). The routine concept typically describes how multiple actions are related and carried out in a specific order. Each of these actions are carried out by individuals or teams of HCPs whose behaviours are driven by any combination of reflective and non-reflective processes that operate on an intra-individual level. Therefore, routines include multiple actions, some of which are more habitual than others. Habitual behaviours are thus often important sub-components of routines. In the next sections, we focus specifically on those healthcare routines that are likely to have a non-reflective (habitual) component, and discuss theoretical factors that impact on habitual and routine clinical behaviours that offer useful targets for intervention strategies.

### 5. Factors influencing habit

The habit literature identifies a number of factors which influence the relationship between habit and behaviour. These factors both influence the likelihood that HCPs will rely on habits (rather than reflective processes), and factors that contribute to the formation of habitual behaviours (i.e., that facilitate the transition from reflective to non-

reflective processing). Dual process models posit that *diminishing motivation* (e.g., due to fatigue, stress or time pressure) may interfere with the operation of the reflective system, whilst prompting more non-reflective reactions (Hofmann et al., 2008). These factors can both diminish reflective motivation by making a behaviour less appealing, and also, by limiting our self-regulatory resources (Neal et al., 2013), preventing us from engaging in the reflective process. There is research evidence to suggest that HCPs revert to habits when they are fatigued or under time pressure. This can be problematic where such habits promote suboptimal performance. A study using longitudinal field observations found that hand hygiene compliance after interacting with patients decreased steadily over a 12-h shift (Dai et al., 2015). The study showed that high work intensity increased the rate with which hand hygiene compliance declined (Dai et al., 2015). In this instance fatigue promoted ‘bad’ handwashing habits (e.g., habitually rinsing hands with water only), whilst preventing reflective performance of a better alternative (e.g., washing using soap). Longer breaks between shifts had a positive effect on compliance, highlighting the need to allow time for replenishing cognitive resources in HCPs during times of increased work intensity (Dai et al., 2015). Similarly, a study using billing and electronic health record data found that the rate of inappropriate antibiotic prescribing for acute respiratory infections increased over the course of HCPs’ day (Linder et al., 2014). An experimental within-subject study in 34 GPs found greater time pressure (as a result of high workload) was associated with lower adherence to guidelines. A better understanding of the factors that affect the likelihood of HCPs acting habitually may lead to novel implementation approaches that harness our understanding of work breaks and optimal work performance in the healthcare context.

One factor that may contribute to the formation of habitual behaviour is *professional experience*. The Novice to Expert Theory (NET) posits that HCPs advance through five levels of proficiency as they learn new skills: *novice, advanced beginner, competent, proficient, and expert* (Benner, 1982). According to NET, HCPs during the early stages of skill acquisition (i.e., novice and advanced beginner stage) rely more heavily on

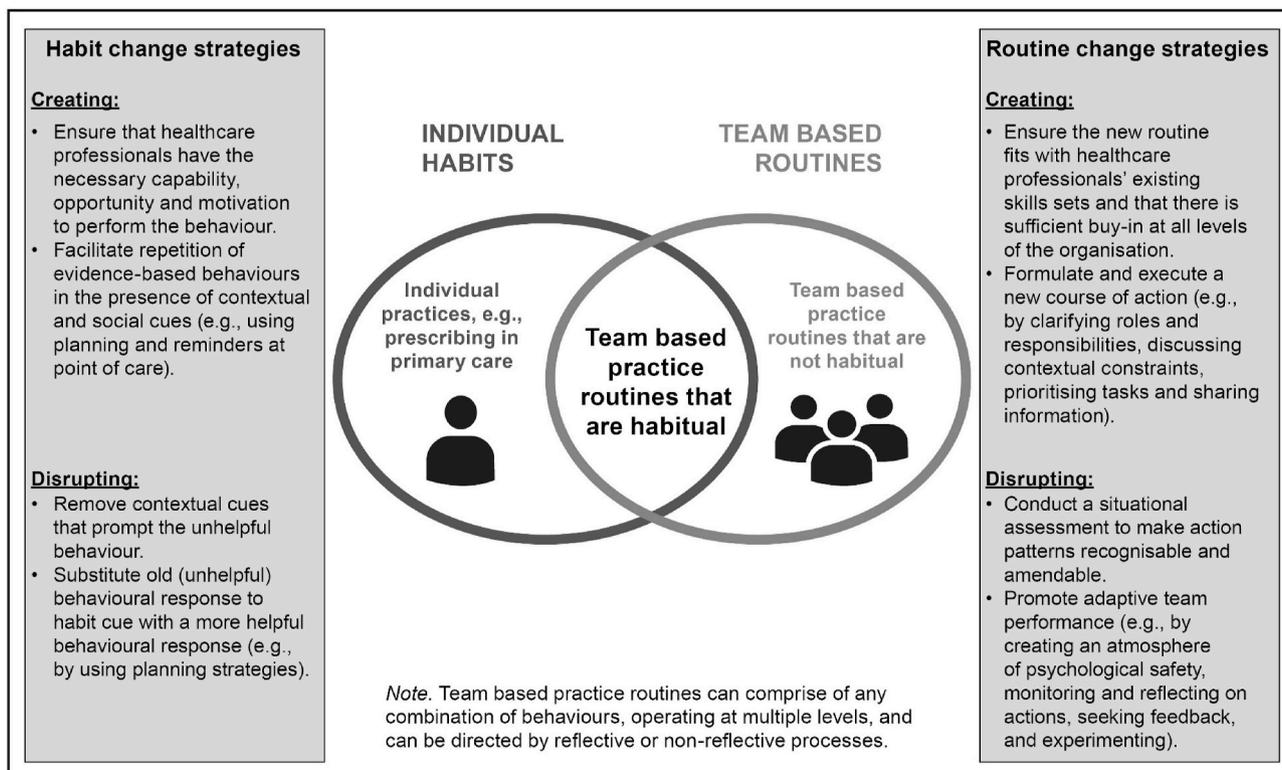


Fig. 1. Overlap between habits and routines.

reflective decision-making as they apply rules they have learned during their training (Benner, 1982). For example, initially providing physical activity advice may require HCPs to actively recall the guidelines, which may be a deliberate and effortful process. However, as HCPs gain more experience with providing physical activity advice they will be able to recall guidelines fast and effortlessly and provide advice intuitively (Presseau et al., 2014). In fact, at high levels of expertise the reflective pathway may be activated predominantly in novel or challenging situations (Benner, 1982). The NET highlights the importance of tailoring behaviour change strategies to the level of skill acquisition (Benner, 1982). For example, in the early stages of skill acquisition (habit formation), HCPs may benefit from observing experts and practising procedures in a safe environment (e.g., practice consultations). More experienced HCPs may need to watch videos of their own behaviours or receive feedback from others to reflect and change their habits where needed. To advance our understanding of the role of experience in relationship to habits, future research should continue to explore strategies that support learning at different stages of skill acquisition.

## 6. Factors influencing routines

From an organisational perspective *situational strength* has been highlighted as an important factor influencing HCPs' routines. Situational strength describes the magnitude of implicit or explicit cues designed to exert psychological pressure on individuals to enact or refrain from enacting a specific course of action (Meyer et al., 2010). A theoretical review identified four facets of situational strength: *clarity*, *consistency*, *constraints*, and *consequences* (Meyer et al., 2010). *Clarity* emphasises the importance of providing cues that are clear and easily understandable. For example, checklists are often used in intensive care units to ensure that all necessary elements or actions are addressed (Winters et al., 2009). *Consistency* describes the extent to which different cues are compatible with each other. For example, whether or not the hospital's operating procedures are in line with clinical guidelines of best practice. *Constraints* are defined as the extent to which outside forces restrict people's decision-making freedom and action. For example, whether organisational norms and regulations promote or inhibit a team climate where everyone is invited to offer an opinion or perspective (Edmondson et al., 2001). *Consequences* are defined as the extent to which decisions or actions are rewarded or punished by relevant entities.

For example, the use of payment schemes in primary care, including financial incentives to reward performance and quality of care is increasing in a number of countries (Scott et al., 2011). When considering non-reflective routines in particular, situational strength captures environmental constraints, operating predominantly at organisational level of analysis, on opportunities for non-reflective action. The ultimate strength of a situation depends on the unique effects of each facet. For example, a situation where a consultant provides specific instructions to a junior doctor pertaining to the best way to treat a patient (high clarity) is stronger than a situation wherein these instructions are not present (low clarity). That being said, a situation wherein these instructions are given is weaker than the same situation wherein the consultant also explains how the instructed behaviour is going to lead to better patient outcomes (high clarity and high consequences). A situation with high clarity and high consequences is likely to facilitate non-reflective behaviour, because it reduces uncertainty about how to respond in this situation, reducing the need for reflective decision-making. Empirical work within the healthcare context is needed to determine precisely how to combine different facets to align work processes with organisational policy and achieve safe and effective practices. Theory-based factors that impact on habitual and routine clinical practices are useful targets for interventions aimed at changing non-reflective behaviours. In the next section, we will describe a selection of theory-based strategies to create and disrupt non-reflective behaviour in HCPs.

## 7. Creating habits and routines

The theoretical distinctions between habit and routine approaches suggest different strategies for supporting HCPs with behaviour change. This includes introducing new habits and routines for delivering care, substituting old ways of providing care with new practices, or stopping the provision of care that is outdated and/or potentially harmful. Here we describe a selection of potential approaches to shaping non-reflective behaviours in HCPs.

### 7.1. Creating habits in healthcare professionals

A psychological habit approach suggests the use of *reminders* at point of care and *volitional planning* interventions to support the formation of habit. The introduction of *reminders* at the point of taking clinical action (both electronic and paper-based) is one way of triggering repetition, and the effectiveness of this strategy to change HCP behaviour has been demonstrated in systematic reviews (Shojania et al., 2010). Balancing the use of tailored electronic pop-up reminders with other strategies aimed at influencing habit or routine enactment may be one way to avoid 'alert fatigue' (too many alerts), which can result in HCPs disengaging from promoted practice (Campbell et al., 2006).

*Planning interventions* (e.g., action and coping planning or implementation intentions) make use of the reflective system to 'program the mind' to perform new sequences of action (Hagger et al., 2016). Action plans specify when, where and how to perform a new behaviour and can be formulated in groups or by individual HCPs. For example, an action plan to promote hand hygiene before patient contact could be "When I enter a patient's room, then I will clean my hands using hand gel before touching the patient or their environment". Coping plans specify how to overcome anticipated barriers to one's goals, if the initial action plan is not possible (Kwasnicka et al., 2013). For example, a coping plan could be "If the hand gel dispenser in the patient's room is empty, then I will ask an assistant to refill it". Within the literature there is a strong emphasis on identifying barriers to implementation and tailoring strategies to help overcome those barriers (Baker et al., 2015). Coping planning could play a key role in tailoring individual level implementations strategies, where HCPs are experiencing barriers to delivering an evidence-based intervention. During educational outreach visits HCPs could be asked to collectively form coping plans based on barriers identified in the literature and those stemming from their own experience. There is strong evidence from systematic reviews showing the effectiveness of planning interventions for changing behaviours of patients and the public (Bélanger-Gravel et al., 2013) and evidence is starting to emerge for their effect on HCP behaviour (Squires et al., 2013). One study found that 80% of HCPs who formed a specific plan in addition to receiving training for a new procedure changed their behaviour, compared to 58% of those who received the training alone (Casper, 2008). HCPs who formulate a specific plan may create cognitive links between opportunities to act and appropriate actions, allowing them to respond intuitively, rather than having to rely on effortful decision-making when faced with competing demands (Potthoff et al., 2017).

### 7.2. Creating routines in healthcare professionals

The organisational literature suggests effective *team leadership* and *team adaptation* for creating routines in HCPs. Effective team leadership is seen to support collective learning and routine formation. A meta-analysis of 43 empirical studies reporting 92 effect sizes showed that team leadership behaviour could explain 18% of the variance in team learning behaviour (Koeslag-Kreunen et al., 2018). *Team learning* is defined as "an ongoing process of reflection and action characterised by asking questions, seeking feedback, experimenting, reflecting on results, and discussing errors or unexpected outcomes of action" (Edmondson, 1999 p. 353). The meta-analysis provides evidence that learning

behaviour in teams that aim to create new routines, is supported by a shared, person-focused approach to leadership (Koeslag-Kreunen et al., 2018). Shared team leadership behaviours encourage communication, self-management, and challenge team members to invest themselves beyond their self-interest (Burke et al., 2006). A shared leadership approach, as opposed to a vertical approach, increases team members' interdependence when they explore alternative solutions to questions for which single leaders do not have the answer. A qualitative study of 16 hospitals implementing new technology for cardiac surgery found that organisations that were the most efficient in establishing new routines were those with team leaders who invited others to engage in the change process by signaling openness to feedback and not rejecting new team behaviours (Edmondson et al., 2001). In contrast, organisations that had team leaders who did not provide a rationale for change, discouraged others' input and rejected new behaviours of team members were more likely to fail in implementing new routines (Edmondson et al., 2001). This work demonstrates the benefits of a group-level perspective when trying to change organisational routines.

A conceptual analysis and model of *team adaptation* provides further insights into how new routines may be formed (Burke et al., 2006). According to this model, there are four phases important in the formation of a routine including: *situation assessment*, *plan formulation*, *plan execution*, and *team learning*. A situational assessment involves making action patterns recognisable and amenable for change. Communication throughout this phase leads to a shared mental model, which forms the foundation for changes in routines. Plan formulation involves setting goals, clarifying team members' roles and responsibilities, discussing relevant contextual constraints, prioritising tasks, and sharing relevant information. Clear and accurate communication is essential throughout the plan execution phase. Lastly, the model suggests an ongoing team learning process involving monitoring and reflecting on actions, asking questions, seeking feedback, experimenting, discussing errors or unforeseen outcomes of action (Edmondson, 1999). Here we identified a selection of theory-based intervention strategies that could be used to facilitate non-reflective behaviours. Evaluation of these interventions need to integrate appropriate designs and methods to establish their impact on HCPs' habits and routines.

## 8. Disrupting habits and routines

The de-implementation of medical practices that are unproven, outdated, contradicted, inefficient and/or potentially harmful is one of the major challenges in implementation science (Prasad and Ioannidis, 2014). Research has shown that there are many practices that have no evidence to support their effectiveness and efficiency or where the negative side-effects outweigh the benefits or simply when new practices emerge that are more effective or efficient than previous ones (Grimshaw et al., 2020).

### 8.1. Disrupting habits in healthcare professionals

A habit perspective suggests the *removal of contextual cues*, the *substitution of behavioural responses* using planning interventions, or the *slowing down* of actions may be used to disrupt unhelpful practices. Once a behaviour has become habitual it is prompted by contextual cues rather than deliberative decision-making. Therefore, one strategy to disrupt a habit is to remove all the contextual cues that may trigger automatic responses (Gardner et al., 2019). For example, a meta-analysis of 108 studies has highlighted that on average 30% of the 50 most commonly ordered laboratory tests in medicine are unnecessary (Cadogan et al., 2015). One way of disrupting this habitual behaviour could involve removing check-boxes on test ordering forms that may trigger the habit (Thomas et al., 2015). Future research into removal of check-boxes for test ordering needs to explore any potential adverse effects on patients. To prevent adverse effects HCPs could be provided with memos to make them aware of this change and let them know how

to manually write the test in if they need it. Another caveat of this approach is that HCPs may not be aware of the cues that trigger their habitual behaviour in which case research may have to establish what those cues may be (e.g. using video observations and/or video stimulated recall). Disruption of contextual cues may sometimes occur naturally, for instance due to re-organisations or events such as the Covid-19 crisis. In those circumstances some habits and routines may no longer be viable or may have to be temporarily replaced. One may thus capitalise on such events by implementing new or revised routines on a more permanent basis. Interventions that were focused on such discontinuities have been found more effective than when these were done under default conditions (Verplanken and Roy, 2016).

Where the removal of cues is not feasible (e.g., patients acting as a social cue by asking for an over-prescribed medicine), HCPs may change their response towards the cue (Johnston, 2016). Action planning may be used to help HCPs specify more desirable responses to a habit cue. An action plan to prevent overprescribing could be constructed as follows "If a patient with an upper respiratory tract infection asks for an antibiotic, then I will provide information about why antibiotics are not appropriate and provide advice to manage their symptoms with self-care" (Tweek et al., 2016). Action plans can be formulated by individuals or in a team of HCPs. For example, a randomised controlled trial in UK HCPs found that habits of poor hand-hygiene compliance (e.g., washing hands without soap) in hospital Intensive Therapy Units could be disrupted by coupling feedback to personal and team level action plans (Fuller et al., 2012). Monthly recurring cycles of weekly 20-min observations of individual staff members' hand hygiene compliance were followed by verbally delivered feedback by a member of staff (the ward coordinator) (Fuller et al., 2012). In cases of poor hand-hygiene compliance the ward coordinator would support them with formulating an action plan to improve behaviour (Fuller et al., 2012). Continued poor compliance resulted in further observations, whereas good compliance was rewarded with a certificate to support HCPs' annual professional development appraisal. In summary, disrupting existing habits can be difficult, especially when HCPs lack sufficient self-regulatory capacities or motivation to change their behaviour. The removal of contextual cues is one way of preventing unhelpful habitual behaviour. Where removal of cues is not feasible, HCPs should harness the power of simple but yet effective plans to substitute unhelpful habitual responses with more evidence-based behaviours.

Another strategy for disrupting unhelpful habits is to encourage HCPs to 'slow down' their behaviours, so that they can become more attuned to the dynamic nature of their practices. For example, an in-depth ethnographic study involving interviews and observations with surgeons investigated the manifestation of the 'slowing down' phenomenon (Moulton et al., 2010). Using in-depth interviews and observations the study demonstrated that expert surgeons would deliberately slow down their movements to make them more deliberate and simultaneously retain control during critical moments of surgery (Moulton et al., 2010). Different ways of slowing down allowed the highly trained, expert surgeons to transition from non-reflective into a more reflective state as the situation required.

### 8.2. Disrupting routines in healthcare professionals

The organisational literature emphasises the role of *team learning* and *psychological safety* processes in disrupting existing routines (Edmondson et al., 2001). To disrupt a routine, members of a group need to jointly monitor and reflect about their team processes and behaviour (Burke et al., 2006). These activities are intended to facilitate a joint understanding (*shared mental models*) of a given situation and help discover the consequences of previous actions (Schippers et al., 2003). Engaging in these activities can help instill new knowledge in the team, which ultimately can support changes in existing patterns of action (Olivera and Argote, 1999). For example, multidisciplinary rounds in acute care

settings are clinical problem-solving and planning episodes involving doctors, nurses and other HCPs (e.g., pharmacists), to engage with patients and their families. Multidisciplinary rounds are an example of team learning, whereby improved communication and shared awareness facilitates the disruption of old unhelpful routines (i.e., working in isolation with limited shared awareness). A review suggests that cohesive teamwork leads to limited adverse events, improved outcomes, decreased length of hospital stay and greater patient and staff satisfaction (Epstein, 2014). For example, research has shown that involving pharmacists on physician rounds in an intensive care unit can help reducing unnecessary prescribing orders by 66%, because of the added expertise in medication (Leape, 1999).

The role of *psychological safety*, which describes a shared understanding that experimentation and risk taking will not be punished, is highlighted as one of the main catalysts of team learning and forming new routines (Edmondson, 2003). Team leaders can promote psychological safety by allowing interpersonal risks to be taken and allowing people to speak their minds. A team learning approach could be applied to disrupting a routine of unnecessary laboratory test ordering (Cadogan et al., 2015). This could involve a team meeting where HCPs are asked to identify scenarios in their own practice when test ordering may be unnecessary. The team leader could share evidence about the costs (e.g., overloading diagnostic services) and risks (e.g., unnecessary patient discomfort) associated with unnecessary test ordering and facilitate a shared discussion on how to reduce test ordering. Importantly, it would be the role of the team leader to create a climate where all members of the team feel comfortable to contribute to the discussion and share their solutions. A systematic review on speaking up in the operating room suggested the use of checklists and time-out strategies to help overcome barriers to speaking up (Pattni et al., 2019). The review further concluded that leaders need to create a culture of respect and safety by engaging frontline staff members and introducing a zero tolerance policy for disrespectful behaviour.

## 9. Changing non-reflective behaviours in healthcare professionals

Fig. 1 offers a conceptual explanation for non-reflective processes (i.e., habits and routines) and how they impact on HCP behaviour, including strategies for changing them. The Venn diagram in the centre of the model shows how implementation and de-implementation involves changing both individual and team-based HCP behaviours. Both individual and team-based behaviours are driven by both reflective and non-reflective processes, the latter of which maintain behaviour in the long-term. The boxes on either side of the Venn diagram define the key strategies and mechanisms that are involved in changing habits and routines respectively, considering both the intra-psychological and organisational level drivers of behaviour. An important prerequisite to creating and disrupting habits and routines is that HCPs have strong intentions and organisations provide sufficient support for the change to be implemented.

## 10. Discussion

We have described a range of theory-based factors that may impact on habits and routines and could provide opportunities for research on how to change non-reflective behaviours in HCPs to improve the quality of care. In this final section we discuss the research agenda raised throughout this article. From an intra-individual habit perspective, more research is needed to explore how factors such as fatigue, stress and time pressure affect the implementation of evidence-based practices, e.g., if habitual behaviours (e.g., overprescribing of medication) are performed more frequently when HCPs are under stress (e.g., busy clinic) (Deutsch and Strack, 2008). The need for adequate breaks to prevent fatigue has become especially apparent during the Covid-19 pandemic which has resulted in HCPs spending time continuously 'on tasks'. One possible

strategy could be to implement 'microbreaks' of a few minutes duration to mitigate the cognitive fatigue (Park et al., 2017). Research should also explore how professional experience moderates the habit-behaviour relationship and how specific strategies support behaviour change at different levels of expertise (Benner, 1982). Psychological dual process models provide a useful lens for understanding moderating factors and intervention strategies for targeting habit, although some have scrutinised their conceptual underpinning and predictive power (Keren and Schul, 2009).

From an organisational-level perspective more research is required to determine how different facets of situational strength affect the implementation of routines (Meyer et al., 2010). Specifically, research could explore whether practices are more likely to become routinised when they are situated in a context where there are consistent cues, norms and consequences that support the practice. Vice versa, when trying to disrupt a routine one might want to consider how to make a situation 'weaker' (e.g., by removing cues and changing norms) to prevent unhelpful routines from being reproduced. Organisational-level theories suggest that there is an increased chance of creating and disrupting routines in an environment of psychological safety where team members are self-determined and feel free to explore new possibilities of action without having to fear negative repercussions (Edmondson, 1999).

We have proposed a selection of theory-based strategies for supporting change in non-reflective clinical behaviours. Psychological theories highlight the importance of planning and using reminders at point of care when supporting HCPs with repeating a behaviour in a specific setting until it becomes non-reflective. An organisational perspective further emphasises that routines need to be formed as part of a team learning process, including collective formation and monitoring of action plans, which are then enacted in a highly flexible and adaptive way. Research could explore whether individual action plans are more effective when they are augmented with collective action planning. Planning interventions can be delivered in a variety of ways and more research is needed to identify the most effective way of forming individual and team-level plans (Hagger et al., 2016).

Similarly, we have described how strategies from both perspectives can be used to disrupt existing non-reflective behaviours. From a psychological perspective, habit is best stopped by discontinuing the exposure to cues that trigger the non-reflective behaviour. Or where removal of cues is impossible, planning can be used to substitute the old (unhelpful) response to the cue with a more desirable response. A routine perspective highlights the importance of engaging in a collective reflection process whereby cues are identified together and new responses are defined with everyone's roles and responsibilities in mind.

One approach that can facilitate the operationalisation of the suggested strategies and develop theory- and evidence-based implementation interventions is Implementation Mapping (Fernandez et al., 2019), an extension of Intervention Mapping (IM) (Bartholomew et al., 2016). IM provides methods for change, including parameters for effectiveness and efficiency, that are relevant for implementation: i.e., basic methods at the individual level, methods to change habitual and automatic behaviours, basic methods for change of environmental conditions, and methods to change organisations (Bartholomew et al., 2016; Fernandez et al., 2019). One way of evaluating theory-based intervention to address non-reflective processes at scale, is by conducting head-to-head trials of different variants of such interventions (Grimshaw et al., 2011). Implementation laboratories, in which researchers and HCPs collaborate closely, provide an ideal platform to conduct such theory-based evaluations, that help answering the question of what works and why in interventions aimed at improving implementation (Ivers and Grimshaw, 2016).

Future research should explore and combine different methods of measuring non-reflective processes (Potthoff et al., 2018). To date, research on HCP habits has overly relied on self-reported measures, despite known limitations (e.g., people being unaware and therefore

unable to report on their non-reflective behaviours) (Potthoff et al., 2019; Sniehotta and Presseau, 2012). Ethnographic methods in combination with conversation analysis might offer a robust way of assessing cues and habitual behaviours by studying interactions, paying attention to both verbal and non-verbal cues (Heath et al., 2020; Pope, 2005). Given the tacit and fleeting nature of interactions the use of video analysis provides the researcher with the opportunity to repeatedly observe the phenomena under scrutiny (Drew et al., 2001). This approach offers a unique way of studying the dynamic patterns of action that take place in the medical context (e.g., operating rooms in hospitals or waiting rooms in practices), including movements of patients and professionals, the (re)arrangement of medical equipment, or assembly of medical tools. When planning ethnographic research, it is important to consider some common hurdles such as gaining access, trust and ethical approval. Building relationships and alliances with influential gatekeepers in the organisation may facilitate entry and approval of key stakeholders (Pope, 2005). Future research could also combine self-reported measures of habit with team-based measures of normalization (i.e., the process of a practice becoming a normal part of everyday work). For example, the Normalization MeASURE Development questionnaire (NoMAD) assesses how different people work together when trying to embed a new practice into their routine (Finch et al., 2018; Rapley et al., 2018). NoMAD is an extension of the Normalization Process Theory (NPT), which provides a theory of implementation that highlights the importance of collective action in embedding new practices (May and Finch, 2009). Self-reported measures should be combined with in-depth ethnographic methods to help us understand how routines are formed, adapted and discontinued over time.

## 11. Conclusion

Research has highlighted the importance of addressing non-reflective processes and reflective processes when supporting HCPs with changing their behaviour to improve the quality of care. Building on the work of Nilsen and colleagues (Nilsen et al., 2012) on the role of habit in implementation science, this article contributes by combining an intra-individual habit perspective with a broader organisational-level routine perspective. Researchers from outside of the behavioural science and health psychology field also explored the overlap between habits and routines. For instance, the researchers assessing organisational and psychology literature on information systems pointed out that habits are directly embedded in more complex task sequences within organisational and individual level routines (Polites and Karahanna, 2013). A combination of both approaches offers a broader range of interventional approaches that capitalises both on behaviour change techniques and social interactive mechanisms for change.

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## Declaration of competing interest

None.

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## References

- Baker, R., Camosso-Stefinovic, J., Gillies, C., Shaw, E.J., Cheater, F., Flottorp, S., Robertson, N., Wensing, M., Fiander, M., Eccles, M.P., Godycki-Cwirko, M., van Lieshout, J., Jäger, C., 2015. Tailored interventions to address determinants of practice. *Cochrane Database Syst. Rev.* CD005470 <https://doi.org/10.1002/14651858.CD005470.pub3>.
- Bargh, J.A., Chen, M., Burrows, L., 1996. Automaticity of social behavior: direct effects of trait construct and stereotype activation on action. *J. Pers. Soc. Psychol.* 71, 230–244. <https://doi.org/10.1037/0022-3514.71.2.230>.
- Bartholomew, L.K., Markham, C.M., Ruiter, R.A.C., Fernández, M.E., Kok, G., Parcel, G.S., 2016. *Planning Health Promotion Programs: an Intervention Mapping Approach, fourth ed.* John Wiley & Sons, San Francisco, CA.
- Bélangier-Gravel, A., Godin, G., Amireault, S., 2013. A meta-analytic review of the effect of implementation intentions on physical activity. *Health Psychol. Rev.* 7, 23–54. <https://doi.org/10.1080/17437199.2011.560095>.
- Benner, P., 1982. From novice to expert. *Am. J. Nurs.* 82 (402) <https://doi.org/10.2307/3462928>.
- Bourdieu, P., 1977. *Outline of a theory of practice.* Cambridge University Press, Cambridge. <https://doi.org/10.1017/CBO9780511812507>.
- Burke, C.S., Stagl, K.C., Salas, E., Pierce, L., Kendall, D., 2006. Understanding team adaptation: a conceptual analysis and model. *J. Appl. Psychol.* 91, 1189–1207. <https://doi.org/10.1037/0021-9010.91.6.1189>.
- Cadogan, S.L., Browne, J.P., Bradley, C.P., Cahill, M.R., 2015. The effectiveness of interventions to improve laboratory requesting patterns among primary care physicians: a systematic review. *Implement. Sci.* 10, 167. <https://doi.org/10.1186/s13012-015-0356-4>.
- Campbell, E.M., Sittig, D.F., Ash, J.S., Guappone, K.P., Dykstra, R.H., 2006. Types of unintended consequences related to computerized provider order entry. *J. Am. Med. Assoc.* JAMIA 13, 547–556. <https://doi.org/10.1197/jamia.M2042>.
- Casper, E.S., 2008. Using implementation intentions to teach practitioners: changing practice behaviors via continuing education. *Psychiatr. Serv.* 59, 747–752. <https://doi.org/10.1176/ps.2008.59.7.747>. Washington DC.
- Dai, H., Milkman, K.L., Hofmann, D.A., Staats, B.R., 2015. The impact of time at work and time off from work on rule compliance: the case of hand hygiene in health care. *J. Appl. Psychol.* 100, 846–862. <https://doi.org/10.1037/a0038067>.
- Deutsch, R., Strack, F., 2008. Variants of judgment and decision making: the perspective of the reflective-impulsive model. In: *Intuition in Judgment and Decision Making.* Lawrence Erlbaum Associates Publishers, Mahwah, NJ, US, pp. 39–53.
- Drew, P., Chatwin, J., Collins, S., 2001. Conversation analysis: a method for research into interactions between patients and health-care professionals. *Health Expect. Int. J. Publ. Particip. Health Care Health Pol.* 4, 58–70. <https://doi.org/10.1046/j.1369-6513.2001.00125.x>.
- Eccles, M.P., Grimshaw, J.M., MacLennan, G., Bonetti, D., Glidewell, L., Pitts, N.B., Steen, N., Thomas, R., Walker, A., Johnston, M., 2012. Explaining clinical behaviors using multiple theoretical models. *Implement. Sci.* 7, 99. <https://doi.org/10.1186/1748-5908-7-99>.

- Edmondson, A., 1999. Psychological safety and learning behavior in work teams. *Adm. Sci. Q.* 44, 350–383. <https://doi.org/10.2307/2666999>.
- Edmondson, A.C., 2003. Speaking up in the operating room: how team leaders promote learning in interdisciplinary action teams. *J. Manag. Stud.* 40, 1419–1452. <https://doi.org/10.1111/1467-6486.00386>.
- Edmondson, A.C., Bohmer, R.M., Pisano, G.P., 2001. Disrupted routines: team learning and new technology implementation in hospitals. *Adm. Sci. Q.* 46, 685–716. <https://doi.org/10.2307/3094828>.
- Epstein, N.E., 2014. Multidisciplinary in-hospital teams improve patient outcomes: a review. *Surg. Neurol. Int.* 5, S295–S303. <https://doi.org/10.4103/2152-7806.139612>.
- Fernandez, M.E., ten Hoor, G.A., van Lieshout, S., Rodriguez, S.A., Beidas, R.S., Parcel, G., Ruiters, R.A.C., Markham, C.M., Kok, G., 2019. Implementation mapping: using intervention mapping to develop implementation strategies. *Front. Public Health* 7. <https://doi.org/10.3389/fpubh.2019.00158>.
- Finch, T.L., Girling, M., May, C.R., Mair, F.S., Murray, E., Trewake, S., McColl, E., Steen, I.N., Cook, C., Vernazza, C.R., Mackintosh, N., Sharma, S., Barbary, G., Steele, J., Rapley, T., 2018. Improving the normalization of complex interventions: part 2 - validation of the NoMAD instrument for assessing implementation work based on normalization process theory (NPT). *BMC Med. Res. Methodol.* 18, 135. <https://doi.org/10.1186/s12874-018-0591-x>.
- Fischer, F., Lange, K., Klose, K., Greiner, W., Kraemer, A., 2016. Barriers and strategies in guideline implementation—A scoping review. *Healthc. Basel Switz.* 4, 36. <https://doi.org/10.3390/healthcare4030036>.
- Fuller, G., Michie, S., Savage, J., McAteer, J., Besser, S., Charlett, A., Hayward, A., Cookson, B.D., Cooper, B.S., Duckworth, G., Jeanes, A., Roberts, J., Teare, L., Stone, S., 2012. The feedback intervention trial (FIT) — improving hand-hygiene compliance in UK healthcare workers: a stepped wedge cluster randomised controlled trial. *PLoS One* 7, e41617. <https://doi.org/10.1371/journal.pone.0041617>.
- Gardner, B., 2015. A review and analysis of the use of ‘habit’ in understanding, predicting and influencing health-related behaviour. *Health Psychol. Rev.* 9, 277–295. <https://doi.org/10.1080/17437199.2013.876238>.
- Gardner, B., Phillips, L.A., Judah, G., 2016. Habitual instigation and habitual execution: definition, measurement, and effects on behaviour frequency. *Br. J. Health Psychol.* 21, 613–630. <https://doi.org/10.1111/bjhp.12189>.
- Gardner, B., Rebar, A.L., Lally, P., 2019. A matter of habit: recognizing the multiple roles of habit in health behaviour. *Br. J. Health Psychol.* 24, 241–249. <https://doi.org/10.1111/bjhp.12369>.
- Godin, G., Bélanger-Gravel, A., Eccles, M., Grimshaw, J., 2008. Healthcare professionals’ intentions and behaviours: a systematic review of studies based on social cognitive theories. *Implement. Sci.* 3, 36. <https://doi.org/10.1186/1748-5908-3-36>.
- Greenhalgh, T., 2008. Role of routines in collaborative work in healthcare organisations. *BMJ* 337, a2448. <https://doi.org/10.1136/bmj.a2448>.
- Grimshaw, J.M., Eccles, M.P., Lavis, J.N., Hill, S.J., Squires, J.E., 2012. Knowledge translation of research findings. *Implement. Sci.* 7, 50. <https://doi.org/10.1186/1748-5908-7-50>.
- Grimshaw, J.M., Eccles, M.P., Steen, N., Johnston, M., Pitts, N.B., Glidewell, L., MacLennan, G., Thomas, R., Bonetti, D., Walker, A., 2011. Applying psychological theories to evidence-based clinical practice: identifying factors predictive of lumbar spine x-ray for low back pain in UK primary care practice. *Implement. Sci.* 6, 55. <https://doi.org/10.1186/1748-5908-6-55>.
- Grimshaw, J.M., Patey, A.M., Kirkham, K.R., Hall, A., Dowling, S.K., Rodondi, N., Ellen, M., Kool, T., van Dulmen, S.A., Kerr, E.A., Linklater, S., Levinson, W., Bhatia, R.S., 2020. De-implementing wisely: developing the evidence base to reduce low-value care. *BMJ Qual. Amp Saf.* 29, 409. <https://doi.org/10.1136/bmjqs-2019-010060>.
- Hagger, M.S., Luszczynska, A., de Wit, J., Benyamini, Y., Burkert, S., Chamberland, P.-E., Chater, A., Dombrowski, S.U., van Dongen, A., French, D.P., Gauchet, A., Hankonen, N., Karekla, M., Kinney, A.Y., Kwasnicka, D., Hing Lo, S., López-Roig, S., Meslot, C., Marques, M.M., Neter, E., Plass, A.M., Potthoff, S., Rennie, L., Scholz, U., Stadler, G., Stolte, E., Ten Hoor, G., Verhoeven, A., Wagner, M., Oettingen, G., Sheeran, P., Gollwitzer, P.M., 2016. Implementation intention and planning interventions in health psychology: recommendations from the synergy expert group for research and practice. *Psychol. Health* 31, 814–839. <https://doi.org/10.1080/08870446.2016.1146719>.
- Heath, C., Hindmarsh, J., Luff, P., 2020. Video in Qualitative Research: Analysing Social Interaction in Everyday Life, vol. 55. City Road, London. <https://doi.org/10.4135/9781526435385>.
- Heatherington, T.F., Wagner, D.D., 2011. Cognitive neuroscience of self-regulation failure. *Trends Cognit. Sci.* 15, 132–139. <https://doi.org/10.1016/j.tics.2010.12.005>.
- Hindmarsh, J., Pilnick, A., 2002. The tacit order of teamwork: collaboration and embodied conduct in anesthesia. *Socio. Q.* 43, 139–164. <https://doi.org/10.1111/j.1533-8525.2002.tb00044.x>.
- Hofmann, W., Friese, M., Wiers, R.W., 2008. Impulsive versus reflective influences on health behavior: a theoretical framework and empirical review. *Health Psychol. Rev.* 2, 111–137. <https://doi.org/10.1080/17437190802617668>.
- Hui, A., Schatzki, T., Shove, E., 2016. *The Nexus of Practices: Connections, Constellations, Practitioners*. Routledge.
- Ivers, N.M., Grimshaw, J.M., 2016. Reducing research waste with implementation laboratories. *Lancet* 388, 547–548. [https://doi.org/10.1016/S0140-6736\(16\)31256-9](https://doi.org/10.1016/S0140-6736(16)31256-9).
- Johnston, M., 2016. What more can we learn from early learning theory? The contemporary relevance for behaviour change interventions. *Br. J. Health Psychol.* 21, 1–10. <https://doi.org/10.1111/bjhp.12165>.
- Keren, G., Schul, Y., 2009. Two is not always better than one: a critical evaluation of two-system theories. *Perspect. Psychol. Sci.* 4, 533–550. <https://doi.org/10.1111/j.1745-6924.2009.01164.x>.
- Koelslag-Kreunen, M., Van den Bossche, P., Hoven, M., Van der Klink, M., Gijssels, W., 2018. When leadership powers team learning: a meta-analysis. *Small Group Res.* 49, 475–513. <https://doi.org/10.1177/1046496418764824>.
- Kuutti, K., Bannon, L.J., 2014. The turn to practice in HCI: towards a research agenda. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. CHI '14. ACM, New York, NY, USA, pp. 3543–3552. <https://doi.org/10.1145/2556288.2557111>.
- Kwasnicka, D., Presseau, J., White, M., Sniehotta, F.F., 2013. Does planning how to cope with anticipated barriers facilitate health-related behaviour change? A systematic review. *Health Psychol. Rev.* 7, 129–145. <https://doi.org/10.1080/17437199.2013.766832>.
- Lally, P., Jaarsveld, C.H.M. van, Potts, H.W.W., Wardle, J., 2010. How are habits formed: modelling habit formation in the real world. *Eur. J. Soc. Psychol.* 40, 998–1009. <https://doi.org/10.1002/ejsp.674>.
- Leape, L.L., 1999. Pharmacist participation on physician rounds and adverse drug events in the intensive care unit. *JAMA* 282, 267. <https://doi.org/10.1001/jama.282.3.267>.
- Linder, J.A., Doctor, J.N., Friedberg, M.W., Reyes Nieva, H., Birks, C., Meeker, D., Fox, C. R., 2014. Time of day and the decision to prescribe antibiotics. *JAMA Intern. Med.* 174, 2029–2031. <https://doi.org/10.1001/jamainternmed.2014.5225>.
- Luff, P., Hindmarsh, J., Heath, C., 2000. *Workplace Studies: Recovering Work Practice and Informing System Design*. Cambridge university press.
- Maniatiopoulos, G., Procter, R., Llewellyn, S., Harvey, G., Boyd, A., 2015. Moving beyond local practice: Reconfiguring the adoption of a breast cancer diagnostic technology. *Soc. Sci. Med.* 131, 98–106.
- May, C., Finch, T., 2009. Implementing, embedding, and integrating practices: an outline of normalization process theory. *Sociology* 43, 535–554. <https://doi.org/10.1177/0038038509103208>.
- Meyer, R.D., Dalal, R.S., Hermida, R., 2010. A review and synthesis of situational strength in the organizational sciences. *J. Manag.* 36, 121–140. <https://doi.org/10.1177/0149206309349309>.
- Moulton, C., Regehr, G., Lingard, L., Merritt, C., MacRae, H., 2010. Slowing down to stay out of trouble in the operating room: remaining attentive in automaticity. *Acad. Med. J. Assoc. Am. Med. Coll.* 85, 1571–1577. <https://doi.org/10.1097/ACM.0b013e3181f073dd>.
- Neal, D.T., Wood, W., Drolet, A., 2013. How do people adhere to goals when willpower is low? The profits (and pitfalls) of strong habits. *J. Pers. Soc. Psychol.* 104, 959–975. <https://doi.org/10.1037/a0032626>.
- Nilsen, P., Potthoff, S., Birken, S.A., 2022. Conceptualising four categories of behaviours: Implications for implementation strategies to achieve behaviour change. *Front. Health Serv.* 1, 795144. <https://doi.org/10.3389/frhs.2021.795144>.
- Nilsen, P., Roback, K., Broström, A., Ellström, P.-E., 2012. Creatures of habit: accounting for the role of habit in implementation research on clinical behaviour change. *Implement. Sci.* 7, 53. <https://doi.org/10.1186/1748-5908-7-53>.
- Olivera, F., Argote, L., 1999. Organizational learning and new product development: CORE processes. In: *Shared Cognition in Organizations: the Management of Knowledge, LEA's Organization and Management Series*. Lawrence Erlbaum Associates Publishers, Mahwah, NJ, US, pp. 297–325.
- Orbell, S., Verplanken, B., 2015. The strength of habit. *Health Psychol. Rev.* 9, 311–317. <https://doi.org/10.1080/17437199.2014.992031>.
- Park, A.E., Zahiri, H.R., Hallbeck, M.S., Augenstein, V., Sutton, E., Yu, D., Lowndes, B.R., Binger, J., 2017. Intraoperative “micro breaks” with targeted stretching enhance surgeon physical function and mental focus: a multicenter cohort study. *Ann. Surg.* 265, 340–346. <https://doi.org/10.1097/SLA.0000000000001665>.
- Pattni, N., Arzola, C., Malavade, A., Varmani, S., Krimus, L., Friedman, Z., 2019. Challenging authority and speaking up in the operating room environment: a narrative synthesis. *Br. J. Anaesth.* 122, 233–244. <https://doi.org/10.1016/j.bja.2018.10.056>.
- Pentland, B.T., 2003. Conceptualizing and measuring variety in the execution of organizational work processes. *Manag. Sci.* 49, 857–870. <https://doi.org/10.1287/mnsc.49.7.857.16382>.
- Pentland, B.T., Feldman, M.S., 2007. Narrative networks: patterns of technology and organization. *Organ. Sci.* 18, 781–795. <https://doi.org/10.1287/orsc.1070.0283>.
- Pentland, B.T., Haerem, T., Hillison, D., 2010. Comparing organizational routines as recurrent patterns of action. *Organ. Stud.* 31, 917–940. <https://doi.org/10.1177/0170840610373200>.
- Polites, G.L., Karahanna, E., 2013. The embeddedness of information systems habits in organizational and individual level routines: development and disruption. *MIS Q.* 37, 221–246.
- Pope, C., 2005. Conducting ethnography in medical settings. *Med. Educ.* 39, 1180–1187. <https://doi.org/10.1111/j.1365-2929.2005.02330.x>.
- Potthoff, S., McCreary, N., Sniehotta, F.F., Presseau, J., 2018. Creating and breaking habit in healthcare professional behaviours to improve healthcare and health. In: Verplanken, B. (Ed.), *The Psychology of Habit: Theory, Mechanisms, Change, and Contexts*. Springer International Publishing, Cham, pp. 247–265. [https://doi.org/10.1007/978-3-319-97529-0\\_14](https://doi.org/10.1007/978-3-319-97529-0_14).
- Potthoff, S., Presseau, J., Sniehotta, F.F., Johnston, M., Elovainio, M., Avery, L., 2017. Planning to be routine: habit as a mediator of the planning-behaviour relationship in healthcare professionals. *Implement. Sci.* 12, 24. <https://doi.org/10.1186/s13012-017-0551-6>.
- Potthoff, S., Rasul, O., Sniehotta, F.F., Marques, M., Beyer, F., Thomson, R., Avery, L., Presseau, J., 2019. The relationship between habit and healthcare professional behaviour in clinical practice: a systematic review and meta-analysis. *Health Psychol. Rev.* 13, 73–90. <https://doi.org/10.1080/17437199.2018.1547119>.

- Prasad, V., Ioannidis, J.P., 2014. Evidence-based de-implementation for contradicted, unproven, and aspiring healthcare practices. *Implement. Sci.* 9, 1. <https://doi.org/10.1186/1748-5908-9-1>.
- Presseau, J., Johnston, M., Heponiemi, T., Elovainio, M., Francis, J.J., Eccles, M.P., Steen, N., Hrisos, S., Stamp, E., Grimshaw, J.M., Hawthorne, G., Sniehotta, F.F., 2014. Reflective and automatic processes in health care professional behaviour: a dual process model tested across multiple behaviours. *Ann. Behav. Med. Publ. Soc. Behav. Med.* 48, 347–358. <https://doi.org/10.1007/s12160-014-9609-8>.
- Rapley, T., Girling, M., Mair, F.S., Murray, E., Treweek, S., McColl, E., Steen, I.N., May, C.R., Finch, T.L., 2018. Improving the normalization of complex interventions: part 1 - development of the NoMAD instrument for assessing implementation work based on normalization process theory (NPT). *BMC Med. Res. Methodol.* 18, 133. <https://doi.org/10.1186/s12874-018-0590-y>.
- Schippers, M.C., Hartog, D.N.D., Koopman, P.L., Wien, J.A., 2003. Diversity and team outcomes: the moderating effects of outcome interdependence and group longevity and the mediating effect of reflexivity. *J. Organ. Behav.* 24, 779–802. <https://doi.org/10.1002/job.220>.
- Scott, A., Sivey, P., Ait Ouakrim, D., Willenberg, L., Naccarella, L., Furler, J., Young, D., 2011. The effect of financial incentives on the quality of health care provided by primary care physicians. *Cochrane Database Syst. Rev.* <https://doi.org/10.1002/14651858.CD008451.pub2>.
- Sheeran, P., Gollwitzer, P.M., Bargh, J.A., 2013. Nonconscious processes and health. *Health Psychol. Off. J. Div. Health Psychol. Am. Psychol. Assoc.* 32, 460–473. <https://doi.org/10.1037/a0029203>.
- Shojania, K.G., Jennings, A., Mayhew, A., Ramsay, C., Eccles, M., Grimshaw, J., 2010. Effect of point-of-care computer reminders on physician behaviour: a systematic review. *CMAJ Can. Med. Assoc. J. Assoc. Medicale Can.* 182, E216–E225. <https://doi.org/10.1503/cmaj.090578>.
- Sniehotta, F.F., Presseau, J., 2012. The habitual use of the self-report habit index. *Ann. Behav. Med. Publ. Soc. Behav. Med.* 43, 139–140. <https://doi.org/10.1007/s12160-011-9305-x>; author reply 141–142.
- Squires, J., Presseau, J., Francis, J., Bond, C.M., Fraser, C., Patey, A., Porteous, T., Vachon, B., Tonelli, M., Yu, C., Grimshaw, J., 2013. Self-formulated conditional plans for changing health behaviour among healthcare consumers and health professionals (Protocol). *Cochrane Database Syst. Rev.* CD010869 <https://doi.org/10.1002/14651858.CD010869>.
- Thomas, R.E., Vaska, M., Naugler, C., Turin, T.C., 2015. Interventions at the laboratory level to reduce laboratory test ordering by family physicians: systematic review. *Clin. Biochem.* 48, 1358–1365. <https://doi.org/10.1016/j.clinbiochem.2015.09.014>.
- Treweek, S., Francis, J.J., Bonetti, D., Barnett, K., Eccles, M.P., Hudson, J., Jones, C., Pitts, N.B., Ricketts, I.W., Sullivan, F., Weal, M., MacLennan, G., 2016. A primary care Web-based Intervention Modeling Experiment replicated behavior changes seen in earlier paper-based experiment. *J. Clin. Epidemiol.* 80, 116–122. <https://doi.org/10.1016/j.jclinepi.2016.07.008>.
- Verplanken, B., Roy, D., 2016. Empowering interventions to promote sustainable lifestyles: testing the habit discontinuity hypothesis in a field experiment. *J. Environ. Psychol.* 45, 127–134. <https://doi.org/10.1016/j.jenvp.2015.11.008>.
- Winters, B.D., Gurses, A.P., Lehmann, H., Sexton, J.B., Rampersad, C.J., Pronovost, P.J., 2009. Clinical review: checklists - translating evidence into practice. *Crit. Care* 13, 210. <https://doi.org/10.1186/cc7792>.
- Wood, W., Quinn, J.M., Kashy, D.A., 2002. Habits in everyday life: thought, emotion, and action. *J. Pers. Soc. Psychol.* 83, 1281–1297. <https://doi.org/10.1037/0022-3514.83.6.1281>.