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REVIEW PAPER

To Choose or Not to Choose?: a Systematic Literature Review Considering the Effects of Antecedent and Consequence Choice upon On-Task and Problem Behaviour

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Abstract
Antecedent choice and consequence choice procedures are often used as interventions to increase on-task behaviour and reduce problem behaviour. This systematic literature review considers the conditions under which individuals show a preference for choice. Results suggest that preference for choice is variable, with some individuals preferring choice which allows access to more highly preferred stimuli and others preferring choice regardless of the outcome's preference value. It is recommended that choice be used as a non-invasive intervention which may positively affect some individuals' behaviour by either allowing them access to more highly preferred items or by accommodating their preference for choice. Trends across different samples and procedures are considered and recommendations are made for future research.

Keywords Choice · On-task behaviour · Problem behaviour · Activity · Reinforcer

Introduction

Procedures which involve providing choice with an aim to decrease problem behaviour and increase on-task behaviour are prevalent in mainstream schools, special schools and support centres for adults with learning disabilities (Morgan 2006). UK government guidance published in 2013 refers to 'choice' as a strategy to 'manage off-task behaviour' (*Managing Challenging Behaviour* 2013, p. 15). Choice is also an important basic right, evidenced by its inclusion in the quality of life domain of self-determination (Schalock and Verdugo 2002). It is important, therefore, to systematically assess the effect of choice on human behaviour when incorporated in evidence-based educational practice.

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Choice interventions may be effective in decreasing problem behaviour and increasing on-task behaviour, defined as active participation in presented activities, in a variety of ways. Consequence choice (i.e. allowing individuals to choose between two or more presumed reinforcers contingent on engaging in target behaviours) may secure access to highly preferred stimuli compared with conditions in which presumed reinforcers are chosen by others and may allow for changing motivating operations of individuals to be captured (Tiger et al. 2006). Choice as an antecedent intervention (e.g. allowing the individual to choose between tasks) may similarly allow access to reduced demands or more preferred activities which are conditions that have often shown to reduce problem behaviour, particularly escape-maintained behaviours (Kern et al. 2001). Additionally, the opportunity to choose autonomously may be reinforcing in itself (Cannella et al. 2005). Offering choice also contains a social attention aspect which may combine with or add to the reinforcing effects of the choice procedure (Morgan 2006).

Evidence-based research focusing on choice is socially significant in a number of ways. Firstly, choice-making is a highly valuable skill applicable to a wide variety of situations throughout an individual's life and supports competence in social interaction, problem solving and independence (Rispoli et al. 2013). Providing opportunities to use effective choice-making is advantageous to the individual, even in

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cases when they already have it in their repertoire (Geiger et al. 2010). Secondly, providing choice is a simple, non-intrusive intervention strategy that can be easily implemented by practitioners (Lane et al. 2015). Finally, if the use of choice as an intervention is preferred, the subsequent reduction of problem behaviour and increase in on-task behaviour provides high social validity for an individual, their family and professionals with whom they associate.

Reviews to date have focused on choice-making yielding different conclusions. Lancioni et al. (1996) evaluated five studies considering the effects of choice on the performance and behaviour of children and adults with severe learning disabilities. Their findings resulted in conflicting evidence, suggesting that choice-making interventions are most effective when choice coincides with access to preferred items or tasks. This reflects a discussion which is still ongoing within the research. Kern et al. (1998) reviewed studies focusing on the effect of antecedent choice upon reducing problem behaviour and increasing desirable behaviour, finding that choice-making positively affected the behaviour of some or all of the participants in each study. Alongside these positive findings, Kern et al. (1998) note that the value of available reinforcement may affect the efficacy of choice-making opportunities. In spite of conflicting evidence found in their review, Lancioni et al. (1996) still recognise that choice-making may have benefits beyond behavioural or task performance implications, such as indirect advantages including positive attention and social acceptance. They commented that more favourable conclusions were found from studies excluded from the analysis which featured participants with mild learning disabilities and went on to suggest that the effect of choice intervention on those with differing level of disabilities be explored. When considering 29 studies evaluating the effect of choice on the performance of school and university students, von Mizener and Williams (2009) reached a different conclusion, that choice-making resulted in better performance for students with disabilities but had less impact on neurotypical students. The effect of choice interventions on adults and children with different disabilities such as autism, emotional and behavioural disabilities and severe and moderate learning disabilities requires further consideration in order to assess which populations, if any, most benefit from choice-making procedures. Reviews of both studies providing antecedent choice and of those providing consequence choice have found that choice-making can result in a reduction of problem behaviour (Cannella et al. 2005; Shogren et al. 2004). Morgan (2006) considered and compared preference and choice-making, showing positive findings for both in classroom situations but also recognising that preference affects choice-making.

Definitions

Choice For the purposes of studying the effects of and preference for choice, Martin et al. (2006) suggest the following definitions. Firstly, *choice conditions* or *free choice* situations involve two or more stimuli available to an individual who selects one of those according to their own preference at the time. The alternative situation would occur if only one stimulus was available. This alternative, where another person selects and provides the stimulus for an individual and therefore only one stimulus is available, is considered *no choice* (Martin et al. 2006). Although it is understood that a choice is still made whether to accept or not accept the provided stimulus, for the purposes of this review, conditions where only one reinforcing stimulus or task is provided will be referred to as *no choice*. Consideration of studies that directly compare these conditions is necessary in order to examine the effects of choice as an intervention strategy in its own right.

Interlinked with the notion of choice is preference, conceptualised herein as the 'subjective liking or disliking' of a particular item, task or activity (Kearney and McKnight 1997, p. 219). *Choice* or *choice making* is the 'act of selecting' a particular stimulus from two or more options (Romaniuk and Miltenberger 2001, p. 152), while *choice availability* or *choice making opportunity* can be defined as circumstances which make it possible for one stimulus to be selected over others. *Preference for choice* is concerned not with the choice of stimuli but with the choice which then provides an opportunity for choice-making, such as initial and terminal link procedures discussed below. Martin et al. (2006) suggest that *preference* is shown and measured as a 'pattern of responding' (p. 236) and *preference for choice* is shown by allowing individuals to make choices which then lead to free choice opportunities as opposed to no choice situations. Cannella et al. (2005) have identified a growing interest among researchers in the interactions between preference and choice-making.

Concurrent Chains Procedures Concurrent schedules of reinforcement, where two or more schedules of reinforcement are simultaneously available, are often used when considering choice-making and preference for choice (Cooper et al. 2007). Concurrent chains procedures have been used to test preference for choice of reinforcement (Ackerlund Brandt et al. 2015; Rost et al. 2014; Tiger et al. 2006) and have also been modified to compare preference for choice of task and choice of reinforcement (Fenerty and Tiger 2010). Concurrent arrangements have been used to assess and evaluate choice-making as a proxy research design in which preference for choice is assessed by considering which of the schedules is chosen by the participant. The number of responses putting into effect one schedule instead of the other then becomes the dependent variable which provides evidence of preference (e.g. Ackerlund Brandt et al. 2015; Fenerty and Tiger 2010;

Fisher et al. 1997; Sellers et al. 2013). Choice can also be assessed by using multiple phases, for example by beginning with a single operant procedure to introduce the choices and consequences to participants before using a concurrent phase to compare preference (Geckeler et al. 2000). Single operant procedures can also be used to assess the effects of antecedent-based choice through use of a reversal design (Dunlap et al. 1994; Kern et al. 2001), alternating treatment design (Liso 2010), multiple baseline design (Watanabe and Sturmey 2003) or a multicomponent design containing a combination of the above (Bambara et al. 1994; Lerman et al. 1997; Mintz et al. 2007). Martin et al. (2006) suggested that 'the most appropriate procedure for demonstrating preference for choice as a consequence is a concurrent chains method... on the other hand, the single-stimulus procedure is more appropriate for demonstrating preference for choice as an antecedent'.

Mazur (2006) identified that a variety of factors can impact upon the choices made in a concurrent chains schedule, such as the amount of reinforcement and timing of the initial and terminal links. Whether preference for choice is affected by potency of reinforcement is a question that has repeatedly arisen when considering the value of choice and the behaviours surrounding choice-making and preference. It is important to ensure that intensity of reinforcement and delay, for example, are equated across all conditions to ensure valid conclusions.

No Choice Conditions Preference for choice can be tested against a variety of no choice conditions. A 'yoked-control phase' can be used (Fisher et al. 1997; Lerman et al. 1997; Tasky et al. 2008) where a stimulus delivered in a no choice phase is matched with a stimulus chosen in the choice phase. This procedure aims to ensure that participants' choices are not directed by access to a more highly preferred item in a choice condition compared to the one delivered in a no choice condition (Martin et al. 2006). Another procedure involves comparing the assignment of a highly preferred stimulus to the choice of highly preferred stimuli. Bambara et al. (1994) and Parsons et al. (1990) compared three conditions: assigned highly preferred task, assigned low preference task and choice of a high and low preference task. Where studies show similar responding in high preference no choice conditions and high preference choice conditions, there could be reason to argue that choice is only beneficial where it gives access to more highly preferred stimuli. If a choice condition has a more favourable effect on behaviour than any no choice condition regardless of the quality of stimuli contained in each condition, strong preference for choice is concluded. Similarly, if a choice of lower preference items yields more beneficial results than an assigned higher preference choice stimulus, preference for choice is concluded. Equating the features of stimuli across experimental conditions is necessary in order to support benefits of choice-making (Fenerty and Tiger 2010). In the same way, effectively controlling the value of stimuli in each condition allows for a detailed examination of when choice may be preferred and the factors which may affect preference for choice. Therefore, preference assessments are vital before the value of stimuli can be either held constant or manipulated in a controlled manner. Even so, these procedures may not take into account preferences that can, at times, change quickly or unexpectedly; therefore, some authors have advocated for the implementation of choice-making conditions as a blanket approach (Cannella et al. 2005).

On-Task and Problem Behaviour The studies included in this review define on-task and problem behaviour differently according to the study focus and participants involved. Some studies give an operational definition as to what constitutes on-task behaviour in specific circumstances or conditions. Parsons et al. (1990), for example, defined on-task behaviour as 'engaging in a work activity by manipulating materials in a manner required to complete a task, requesting assistance or receiving feedback from the instructor' (p. 255) while also including an absence of problem behaviour if waiting for assistance or for a task to become available. Further definitions include eyes on the task (or on teacher/instructor) or completing the task in line with instructions (e.g. Engstrom et al. 2015; Ulke-Kurkcuoglu and Kircaali-Iftar 2010; Watanabe and Sturmey 2003). Some studies list specific dependent variables measured which include time on-task (Skerbetz and Kostewicz 2015), correct responses (Mintz et al. 2007), amount of task completed (Stenhoff et al. 2008), accuracy (Ramsey et al. 2010; Skerbetz and Kostewicz 2015), time taken to complete task (Skerbetz and Kostewicz 2015), and the number of relevant or correct responses (Tiger et al. 2010; Toussaint et al. 2016). The included studies also defined problem behaviour individually for each participant and these definitions range from not attending to the task (Powell and Nelson 1997) to physical aggression and self-injurious behaviours (Humenik et al. 2008).

Research Questions and Aim

As choice may be used as a behaviour management strategy in a wide variety of settings with children (both neurotypical and with various disabilities) and adults (with disabilities), this review will consider the application of choice across a varied subject sample. Cannella et al. (2005) identify that some studies in this field 'indicate that choice interventions have the potential to be successful with a variety of individuals who have a wide range of developmental disabilities' (p. 11), although it is as yet unclear if choice making is more effective with some populations than others. Therefore, the sample will not be limited to specific diagnoses or ages. Comparisons of results across different samples can then be made with a further discussion of any notable outcomes.

The present study systematically reviews the scientific literature addressing the effects of choice interventions and examines whether choice conditions are preferable to no choice conditions. The research questions to be answered are (a) whether individuals show a preference for being provided with choice (antecedent or consequence choice) over being assigned or allocated a task or reinforcer, (b) whether providing individuals with antecedent or consequence choice is effective in increasing on-task behaviour, and (c) whether providing individuals with antecedent or consequence choice is effective in decreasing problem behaviour.

Method

Literature Search Procedure

In May 2016, the first author searched the scientific literature for peer-reviewed journal articles published in English. For this purpose, the Queen's University Belfast QCat article search engine from the Queen's Online library feature was used; QCat accesses 149 electronic databases including, among others, SAGE Journals, PubMed and Wiley. Searches were not limited to specific years of publication or to specific ages or diagnoses, as studies containing varied subject samples allow for the consideration of whether certain populations particularly benefit from choice-making (Cannella et al. 2005).

Searches contained the following combinations of keywords 'reinforcement AND activity AND task AND choice AND choice making or choice-making' and 'choice-making OR choice making AND behavio*r analysis'. The first combination of keywords resulted in 457 studies. Upon screening the title of these, 29 were found to be relevant for further consideration. The second search yielded 525 articles, 44 of which were deemed relevant for further consideration.

Screening and Inclusion Criteria

Screening was conducted by the first author in 2016 and studies were selected which met the following inclusion criteria: (a) study involved human participants of any age and with any or no diagnosis, (b) the intervention involved offering a choice relating to the task to complete, a choice of presumed reinforcer they would receive or a choice of whether to work within a choice condition or no choice condition shown through a concurrent chains procedure (variations included choice of order in which to complete a set of tasks and selecting and/or ordering tasks from a provided list or menu of two or more tasks); studies that included within-task choices (e.g. choice of materials to be used) were disregarded, (c) the dependent variable was the behaviour shown during a choice condition compared with a no choice or baseline condition or the frequency of choice of one condition resulting in choice compared with a second condition resulting in no choice, and (d) studies were original or replicated studies and a single-subject research design was employed in order to gain experimental control.

On screening, studies containing secondary data and studies with independent variables other than those directly offering choice were excluded. After screening titles and abstracts, 73 studies were included. After removing duplicates and conducting a full text screening, a total of 23 studies were selected as eligible. A manual search of the references of selected studies was then conducted identifying an additional 13 relevant studies. At the final stage of screening, two studies were excluded (Fig. 1) for the following reasons. In the study by Lovitt and Curtiss (1969), the participant was given control over reinforcement contingencies including when and how often he accessed reinforcement, rather than choice of reinforcement or task. Peck Peterson et al. (2001) were excluded for not using an appropriate experimental design (Reutebuch et al. 2015). We hypothesise that some of the studies found through manual searches were published in journals not indexed in the databases we searched or employed keywords that were not indicative of their focus on choice.

In May 2018, the third author conducted an independent search with the aim to update the list of eligible studies, adding a further four studies at the abstract screening stage. Therefore, this systematic review contains all eligible studies published or becoming available online first up to and including 2017. In total, the present review includes 38 studies.

Results were assessed by considering the effect of the choice condition upon on-task and problem behaviour or by comparing the number of times a procedure involving an opportunity to choose was selected over a procedure involving no choice.

Data Coding

Eligible studies were collated with key data from each study being organised into a table. Key information coded included number of participants, whether participant was a child or adult, diagnosis (if any), main study focus, and an overview of results. Key information was obtained from article abstracts where possible, with extra information (e.g. number of participants, study design and experimental conditions) being obtained from the full text article (Table 1).

Studies were categorised by outcome. Results were considered and described as *overall positive* or *clearly positive* for studies in which the majority or all participants either showed preference for choice or showed an increase in on-task behaviour or decrease in problem behaviour as a result of choice conditions. *Favourable according to particular factors* refers to results which showed choice to be

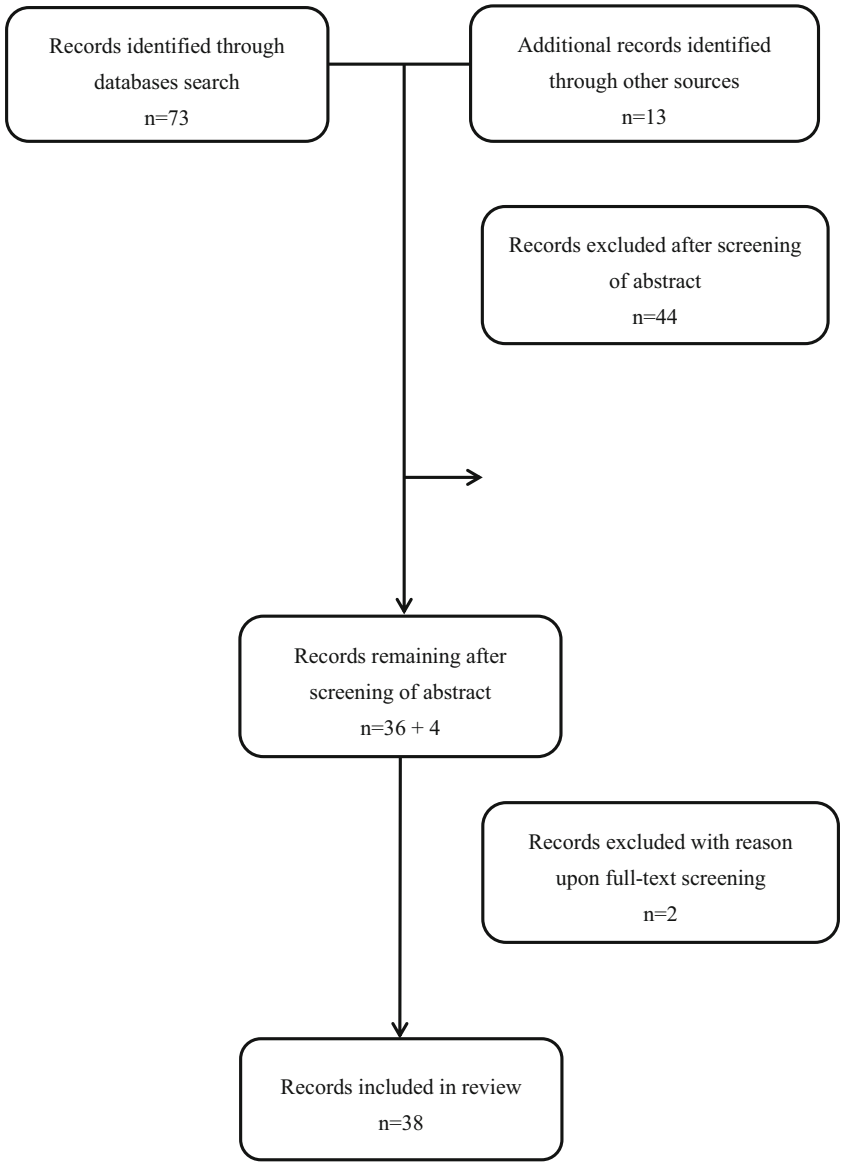

Fig. 1 Flow diagram showing inclusion process

preferred under certain circumstances. These results are considered positive for the purpose of supporting choice interventions, as choice was found to be preferred to at least one other condition or to impact positively on at least one dependent variable, although it is acknowledged that the effectiveness of choice interventions may be influenced by other factors. For example, in Fisher et al. (1997), all participants showed preference for the choice condition compared to the no choice condition when the latter involved reinforcers provided on a yoked schedule. However, when the no choice condition resulted in access to higher preference reinforcers than the choice condition, the no choice condition was preferred. A further example is provided by Tiger et al. (2006), where for three participants choice was preferred, for one participant no choice was preferred, and for two participants choice was initially preferred but this preference did not persist. Results described as *mixed* contain two studies (Lane et al. 2015; Skerbetz and Kostewicz 2015). In Lane et al. (2015), one participant showed increases in on-task behaviour and decreases in problem behaviour as a result of a choice condition, while no functional relation was found for the other participant. Skerbetz and Kostewicz (2015) found no difference in behaviour between conditions in phase one but once the task difficulty increased, two participants engaged more often and for longer when offered choice. *Neutral* refers to the results showing no discernible difference between choice and no choice conditions (Lerman et al. 1997; Liso 2010; Mintz et al. 2007; Smith et al. 1995).

Where a concurrent chains procedure was used, results were assessed by comparing the number of times a procedure

Table 1 Synthesis of main variables coded from eligible studies

Study	Research design	Dependent variables	Conditions	Participant characteristics	Independent variables	Main outcome	Outcomes	Quality assessment
Ackerlund Brandt et al. (2015)	Concurrent chains arrangement	Response (choice of condition in operation)	Concurrent choice and no choice options	*N* = 30 Children Neurotypical	Consequence choice Assessed preference for choice and considered and then assessed effects of differential outcomes on preference for choice	Choice condition preferred when reinforcement was equal in conditions but condition allowing access to higher preference reinforcement preferred when stimuli unequal	Favourable according to particular factors	Strong
Bambara et al. (1994)	Alternating treatment design	On-task behaviour	No choice high preference task, no choice low preference task, choice of high and low preference task and experiment repeated with low and moderate preference tasks	*N* = 5 Adults Severe/profound learning disabilities	Antecedent choice Assessed engagement in 3 conditions; assigned high preference activity, assigned low preference activity and choice of high and low preference tasks Repeated using low and moderate preference tasks	Engagement highest in assigned high preference task condition or choice condition and lowest during the assignment of a low preference task with minimal differences for low and moderate preference tasks 1 participant preferred choice over no choice when stimuli was equal	Favourable according to particular factors	Moderate
Brigham and Sherman (1973)	Concurrent procedure	Response (time spent in each component)	Concurrent control (no reinforcement condition and praise condition), no choice and choice condition	*N* = 2 Children Neurotypical	Consequence choice Assessed preference of tokens able to be exchanged for child selected (choice) or adult selected (no choice) reinforcement	Increased rate of responding and more time spent in child choice condition	Overall positive	Moderate
Carlson et al. (2008)	Multiple baseline design	Public disrobing and urination	Scheduled choice opportunities No choice condition (baseline)	*N* = 2 Children Autism, PDD	Antecedent choice Assessed the effect of 5 antecedent choice-making opportunities on public disrobing and urination	Frequency of both target behaviours reduced following intervention but additional functions of the target behaviours were not explored	Overall positive	Strong
Dunlap et al. (1994)	Reversal design	On-task behaviour and problem behaviour	Choice of task and no choice task condition (1 no choice phase yoked)	*N* = 3 Children EBD	Antecedent choice Assessed the effect of choice of task or assigned task on engagement and disruptive behaviour	Task engagement higher and disruptive behaviour lower in choice condition	Overall positive	Moderate
Dyer et al. (1990)	Reversal design	On-task behaviour and problem behaviour	Choice and no choice conditions of tasks and reinforcers	*N* = 3 Children Learning disabilities	Antecedent choice and consequence choice Assessed the effect of choice of reinforcement or task on disruptive behaviour	Reduced problem behaviours but no effects on the rate of responding on the instructional tasks	Favourable according to particular factors	Moderate
		Skill acquisition		*N* = 3 Children	Consequence choice		Neutral	Moderate

Table 1 (continued)

Study	Research design	Dependent variables	Conditions	Participant characteristics	Independent variables	Main outcome	Outcomes	Quality assessment
Elliott and Dillenburger (2016)	Alternating treatment design		Choice (high preference items) condition and no choice reinforcement condition	ASD	Assessed skill acquisition in a high preference choice condition with skill acquisition in a no choice reinforcement condition with reinforcement selected by tutor	Low to no increase in skill acquisition between choice and no choice conditions		
Engstrom et al. (2015)	Multicomponent	On-task behaviour	Check-in procedure offering choice compared to baseline (no choice)	$N = 5$ Elderly adults Severe dementia	Antecedent choice Assessed engagement with check-in procedure offering choice of activity to dementia patients compared with baseline (no check in and no choices offered)	Engagement increased for 3 participants, modest improvement for 1 other participant and no change for 1 participant	Overall positive	Strong
Fenerty and Tiger (2010)	Modified concurrent chains arrangement	Response (choice of condition in operation)	Concurrent choice of task, choice of reinforcement and no choice and no reinforcement (control) conditions	$N = 4$ Children Neurotypical	Antecedent choice and consequence choice Assessed preference for task choice and consequence choice compared with no choice and no reinforcement control conditions	Preference for consequence choice condition shown by 3 participants with no difference in preference between the task choice and no choice condition	Favourable according to particular factors	Strong
Fisher et al. (1997)	Concurrent chains arrangement	Response (choice of condition in operation)	Concurrent choice or no choice (yoked) condition and choice (low preference) or no choice (high preference) control condition	$N = 3$ Children Learning disabilities and ADHD	Consequence choice Assessed preference for choice condition or yoked no choice condition and also choice (less preferred stimuli) or no choice (more highly preferred stimuli) condition	All participants showed preference for choice condition compared to yoked no choice condition Participants showed preference for the no choice condition when it allowed them to access higher preference stimuli	Favourable according to particular factors	Moderate
Geckeler et al. (2000)	Multicomponent	Response (choice of condition in operation)	Choice of reinforcer and no choice conditions compared in single operant, concurrent schedule and baseline phases	$N = 3$ Children Autism	Consequence choice Assessed preference for reinforcer choice and no choice conditions in single operant, concurrent and baseline phases	No differences in number of responses in single operant phase but higher rates of responding to choice among reinforcers for all participants in concurrent phase	Overall positive	Moderate
Harding et al. (2002)	Concurrent chains arrangement and reversal design	Problem behaviour	Choice of reinforcement and no choice conditions compared in concurrent schedule	$N = 2$ Children PDD	Antecedent choice Assessed how choice of reinforcement condition for task completion reduced destructive problem behaviour	Highly reinforcing work conditions tended to reinforce both problem and on-task behaviour	Neutral	Strong
	Reversal design			$N = 1$	Antecedent choice			Moderate

Table 1 (continued)

Study	Research design	Dependent variables	Conditions	Participant characteristics	Independent variables	Main outcome	Outcomes	Quality assessment
Humenik et al. (2008)		Problem behaviour	Choice and (yoked) no choice condition compared to baseline	Child Autism	Assessed effect of choice (choice of food), no choice and baseline (continuous access to choice and food) on severe injurious behaviour	Problem behaviour (SIB) greatly reduced in choice condition	Overall positive	
Kautz et al. (2018)	Reversal design	Non-compliance, task engagement and duration to complete activities	Choice of task sequence condition was compared with a no choice condition and a no choice yoked condition for 1 participant	$N = 3$ Children ASD and speech and language impairment	Antecedent choice Performance on the dependent variables was compared in 2 conditions: the choice condition in which the participant selected the order of low preferred activities and the no choice condition in which the teacher selected the choice of activities	Choice of task sequence did not impact task engagement but for 2 participants it was effective at reducing non-compliant behaviour	Favourable according to particular factors	Moderate
Kern et al. (2001)	Reversal design	On-task behaviour and/or problem behaviour	Choice of task order and no choice condition (1 no choice phase yoked for 1 participant)	$N = 3$ Children ADHD/learning disabilities	Antecedent choice Assessed effect of choice and no choice condition on problem behaviour for 1 participant, on-task behaviour for another participant and problem and on-task behaviour for the third participant. 1 no choice phase was yoked for 1 participant	Choice conditions resulted in reduced problem behaviour and/or increase engagement for each participant	Overall positive	Moderate
Lane et al. (2015)	Multicomponent	On-task behaviour and problem behaviour	Choice of task order and no choice condition (baseline)	$N = 2$ Children Special educational needs	Antecedent choice Assessed effect of choice of task order and no choice (baseline) conditions (within-task data not included in this review)	Choice condition showed increase in time engaged and reduction in problem behaviour for 1 of the 2 participants	Mixed	Strong
Lerman et al. (1997)	Multicomponent	On-task behaviour	Choice and (yoked) no choice condition compared to baseline	Children ($N = 4$) Adults ($N = 2$) Severe/profound learning disabilities	Consequence choice Assessed effect of choice of reinforcement and (yoked) no choice conditions compared to baseline for on-task responding	No differential rates of responding when value of reinforcement was the same in both choice and no choice conditions	Neutral	Strong
Liso (2010)	Alternating treatment design	On-task behaviour	Choice and no choice condition	$N = 3$ Children Disabilities	Antecedent choice Assessed effects of choice of task and no choice conditions upon on-task behaviour	No difference in engagement across conditions	Neutral	Strong

Table 1 (continued)

Study	Research design	Dependent variables	Conditions	Participant characteristics	Independent variables	Main outcome	Outcomes	Quality assessment
Mintz et al. (2007)	Multicomponent	On-task behaviour	Choice of reinforcer by students and instructor from 2 lists of reinforcers, 1 selected by the instructor and 1 selected by the student	$N = 4$ Children EBD	Consequence choice Assessed effects of student and teacher choices from both student and teacher generated lists of reinforcers on correct responses compared to baseline	All 4 methods of reinforcement effective in increasing accurate responding with no difference between conditions	Neutral	Moderate
Parsons et al. (1990)	Alternating treatment design	On-task behaviour	Choice of task, and 2 no choice conditions (preferred task and non-preferred task)	$N = 4$ Adults Learning disabilities	Antecedent choice Assessed the effects of assignment of a high preference task (based on the previous preference results), assignment of a low preference (non-preferred) task or choice of high preference or low preference task	On-task behaviour increased in assigned high preference condition or choice condition and lowest in assigned low preference task condition	Favourable according to particular factors	Strong
Powell and Nelson (1997)	Reversal design	Problem behaviour	Choice of task and no choice conditions	$N = 1$ Child ADHD	Antecedent choice Assessed the effects of choice of task and no choice conditions on problem behaviour	Problem behaviours decreased during choice conditions	Overall positive	Moderate
Ramsey et al. 2010)	Reversal design	On-task behaviour	Choice of order of tasks and no choice condition	$N = 5$ Children EBD	Antecedent choice Assessed the effects of choice of task sequence upon on-task behaviour	Choice condition positively affected time on-task but accuracy was unaffected	Favourable according to particular factors	Moderate
Rispoli et al. (2013)	Multicomponent	Problem behaviour	Choice of task and no choice condition	$N = 4$ Children Autism	Antecedent choice Compared the effects of choice of task on escape-maintained problem behaviour to no choice baseline (within activity data not included)	Choice resulted in reduction in challenging behaviour for all participants	Overall positive	Strong
Romaniuk et al. (2002)	Reversal design	Problem behaviour	Choice of task and no choice condition	$N = 7$ Children Various diagnoses	Antecedent choice Assessed effects of choice of task and no choice condition on problem behaviour escape or attention-maintained problem behaviour	Escape-maintained problem behaviour reduced substantially during choice conditions but attention-maintained problem behaviour remained at similar levels across both conditions	Favourable according to particular factors	Strong

Table 1 (continued)

Study	Research design	Dependent variables	Conditions	Participant characteristics	Independent variables	Main outcome	Outcomes	Quality assessment
Rost et al. (2014)	Concurrent chains arrangement	Response (choice of condition in operation)	Concurrent choice (3 variations: same in both conditions, higher preference than no choice and lower preference than no choice) and no choice condition	*N* = 14 Adults Neurotypical	Consequence choice Assessed preference for choice when reinforcement value was equal across conditions, higher in the choice condition and higher in the no choice condition	Choice preferred when reinforcement value was equal to or greater than no choice but preference for choice decreased as the potency of the reinforcer reduced	Favourable according to particular factors	Moderate
Schmidt et al. (2009)	Concurrent chains arrangement	Response (choice of condition in operation)	Concurrent choice of reinforcers, no choice and control condition using 2 procedures containing highly preferred edibles or less preferred stickers	*N* = 8 Children Neurotypical	Consequence choice Assessed preference for choice using high and low preference items in choice, no choice and control conditions	Choice was preferred when highly preferred items were available in choice and no choice conditions and also when less preferred items were available in both conditions	Overall positive	Strong
Sellers et al. (2013)	Concurrent chains arrangement	Response (choice of condition in operation)	Initial concurrent choice of reinforcers (high preference), no choice (high preference) and control Further conditions including choice (varied high preference) compared with no choice (yoked) conditions, choice (identical high preference) compared with no choice (identical) conditions and choice (medium preference) compared with no choice (medium preference) conditions	*N* = 4 Children Autism	Consequence choice Assessed preference for choice making opportunities compared in a variety of procedures: choice (varied high preference) and no choice (yoked), choice (identical high preference) and no choice (identical), choice (varied medium preference) and no choice (medium preference)	Results suggest a number of features of choice making opportunities may affect preference for choice (e.g. stimulus variation, higher quality reinforcement)	Favourable according to particular factors	Moderate
Skerbetz and Kostewicz (2013)	Reversal design	On-task behaviour	Choice of task and no choice condition	*N* = 5 Children EBD	Antecedent choice Assessed the effects of choice of task and no choice (baseline) condition on engagement and problem behaviour	Choice conditions resulted in improvements to engagement and academic performance and decrease in student escape-maintained problem behaviour for all except 1 participant	Overall positive	Strong
Skerbetz and Kostewicz (2015)	Alternating treatment design	On-task behaviour	Choice of reinforcement, no choice and control condition	*N* = 4 Children EBD	Consequence choice Assessed the effects of choice of reinforcement, no choice and baseline conditions upon on-task behaviour	No difference in conditions in phase 1 (simple tasks) but engagement increased for 2 students in choice condition when task difficulty increased	Mixed	Strong

Table 1 (continued)

Study	Research design	Dependent variables	Conditions	Participant characteristics	Independent variables	Main outcome	Outcomes	Quality assessment
Smith et al. (1995)	Multicomponent	On-task behaviour	Choice of reinforcement, no choice condition and baseline (no reinforcement)	*N* = 4 Adults Profound learning disabilities	Consequence choice Assessed effects of choice of reinforcement, no choice and baseline conditions upon on-task behaviour	Participants showed increase in responding over baseline but no difference in responding between choice and no choice condition	Neutral	Strong
Stenhoff et al. (2008)	Reversal design	On-task behaviour	Choice of task and no choice condition	*N* = 1 Child Learning disability	Antecedent choice Considered the effects of choice of task and no choice conditions upon on-task behaviour	Highest percent complete and correct when the participant was given a choice of tasks	Overall positive	Moderate
Tasky et al. (2008)	Reversal design	On-task behaviour	Choice of task and no choice condition (1 of which was yoked)	*N* = 3 Adults Traumatic brain injury	Antecedent choice Evaluated effects of choice of task (3 of a menu of 9 and choice of sequence), yoked no choice condition and baseline upon on-task behaviour	Increase in on-task behaviour for all participants in the choice condition with a decrease in on-task behaviour in yoked-control phase	Overall positive	Moderate
Thompson et al. (1998)	Concurrent chains arrangement	Response (choice of condition in operation)	Choice of reinforcement (when reinforcement equal to no choice and lower than no choice) and no choice condition	*N* = 1 Child PDD	Consequence choice Evaluated preference for choice of reinforcement (when conditions produced both equal and lower rates of reinforcement), no choice and control conditions	Participant showed preference for the choice condition even when it produced a lower rate of reinforcement	Overall positive	Moderate
Tiger et al. (2006)	Concurrent chains arrangement	Response (choice of condition in operation)	Choice of reinforcement, no choice and control condition (with further phases altering number of stimuli and response requirement)	*N* = 6 Children Neurotypical	Consequence choice Assessed preference for choice of reinforcer, no choice and control conditions with additional phases increasing number of stimuli and increasing the response requirement	Preference to choose shown by 5 participants (although preference did not persist for 2) and 1 participant demonstrated preference for no choice condition. As numbers of items to choose from increased, choice link selections increased for all participants	Favourable according to particular factors	Strong
Tiger et al. (2010)	Multicomponent	On-task behaviour	Choice of reinforcement and no choice condition using both fixed ratio schedules and then progressive ratio schedules and, for 1 participant, a concurrent operants arrangement	*N* = 3 Children Autism	Consequence choice Compared the effects of choice of reinforcement and no choice conditions upon on-task behaviour in fixed ratio, progressive ratio and, for 1 participant, concurrent format	Task completion similar in both conditions in FR format, rates of task completion increased for 2 participants in choice conditions when a PR schedule format was used, final participant's responding only increased	Favourable according to particular factors	Moderate

Table 1 (continued)

Study	Research design	Dependent variables	Conditions	Participant characteristics	Independent variables	Main outcome	Outcomes	Quality assessment
						when compared in a concurrent operants format		
Toussaint et al. (2016)	Multicomponent (including modified concurrent chains arrangement)	On-task behaviour and response (choice of condition in operation)	Concurrent choice of reinforcement and (yoked) no choice conditions compared with control (where initial link was selected by experimenter) and baseline (no reinforcement) conditions	$N = 3$ Children Autism	Consequence choice Compared effects of choice of reinforcement, no choice and control condition upon on-task behaviour	All participants showed preference for choice conditions and correct responding increased for all participants	Overall positive	Moderate
Ulke-Kurkcuoglu and Kircaali-Iftar (2010)	Reversal design	On-task behaviour	Choice of task and no choice (baseline) conditions	$N = 4$ Children Autism	Antecedent choice Compared the effects of choice of task and no choice conditions upon on-task behaviour (within activity choices of material data not included)	On-task behaviours increased for 3 of the 4 participants during choice conditions compared to baseline	Overall positive	Moderate
Watanabe and Sturmey (2003)	Multiple baseline across subjects	On-task behaviour	Choice of task sequence and no choice (baseline) condition	$N = 3$ Adults Autism	Antecedent choice Evaluated the effects of choice of task sequence and no choice (baseline) conditions upon on-task behaviour	Engagement higher in choice condition compared to baseline for all participants	Overall positive	Strong

ADHD: attention deficit hyperactivity disorder; ASD: autism spectrum disorder; EBD: emotional and behavioural disorders; PDD: pervasive developmental disorder

involving an opportunity to choose was selected over a procedure involving no choice.

Quality Assessment

In order to consider the quality of eligible studies, an assessment was carried out using 14 questions specifically devised for single-subject research designs (Logan et al. 2008). The questions were answered with a yes or no with one point being scored for each yes answer; two questions contained two parts scoring 0.5 each for a yes response. The total score each study obtained resulted in its evidence being categorised as either strong (11–14 points), moderate (7–10) or weak (fewer than 7) (Table 1).

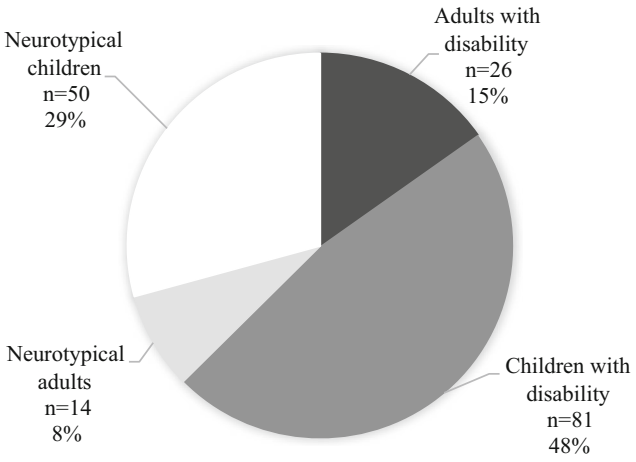

Fig. 2 Number of child and adult participants per diagnosis

Results

The 38 studies included in this review were published between 1973 and 2017, with one study being published in 2018 but becoming available online first in 2017 (Kautz et al. 2018). Almost three quarters of the 38 studies ($n = 28$) were published since 2000, while 10 studies were published between 2013 and 2018.

The studies included a total of 171 participants, 131 children and 40 adults. Six studies contained neurotypical participants, with five of these including a total of 50 neurotypical children and one including 14 neurotypical adults. One study containing a neurotypical sample included one participant with autism spectrum disorder (ASD) (Tiger et al. 2006). As the participant with ASD was completing the same tasks as the neurotypical participants in that study, for the purposes of this review, the study was categorised as containing neurotypical participants. The remaining 32 studies included participants with some form of disability distributed in six studies with a sample of 24 adults with disability, 25 studies with a sample of 77 children with disability and one study containing both four children and two adults with disability (Lerman et al. 1997) (Fig. Fig. 2). Adult disabilities included autism, traumatic brain injury, general learning disabilities and dementia. Child disabilities include ASD, emotional and behavioural disorders (EBD), moderate or severe learning disabilities, speech and language impairments and attention deficit hyperactivity disorder (ADHD).

Sample

Adults and Children Independent of whether studies contained child or adult participants, results were similar in terms of outcomes. Of studies with adult samples, six showed either overall positive results or results which were favourable according to particular factors. Three of these yielded an overall positive result, with choice conditions resulting in increased on-task behaviour for all or a majority of participants (Engstrom et al. 2015; Tasky et al. 2008; Watanabe and Sturmey 2003) while the other three studies showed that results were favourable according to particular factors (Bambara et al. 1994; Parsons et al. 1990; Rost et al. 2014). Two studies including adult participants reported neutral results, with authors stating that choice conditions had no more positive effects than the no choice conditions (Lerman et al. 1997; Smith et al. 1995).

Of studies with child samples, 24 showed that choice conditions positively affected at least one dependent variable compared with at least one no choice condition or baseline (e.g. Fenerty and Tiger 2010; Fisher et al. 1997; Ramsey et al. 2010; Romaniuk et al. 2002). Of these, 14 reported overall positive findings (e.g. Brigham and Sherman 1973; Dunlap et al. 1994; Geckeler et al. 2000; Humenik et al. 2008; Kern et al. 2001) and 10 reported choice to be favourable according to particular factors. For example, Fenerty and Tiger (2010) compared whether four neurotypical children showed preference for choice of task or choice of reinforcer showing that three out of four children preferred the choice of reinforcer condition while the choice of task condition was not found to be preferable to the no choice condition. Ramsey et al. (2010) found that, when allowing children with EBD to choose which task they wanted to complete first, time on-task and the amount of task completed increased but the task accuracy was not affected positively in the same way. Romaniuk et al. (2002) found that escape-maintained problem behaviour substantially decreased upon participants being offered choice of tasks, although attention-maintained problem behaviour did not improve as a result of being offered choice. Five studies with child participants reported neutral findings (Elliott and Dillenburger 2016; Harding et al. 2002; Lerman et al. 1997; Liso 2010; Mintz et al. 2007). A further two reported mixed results with a functional relation between choice conditions and engagement for one of the two participants in (Lane et al. 2015) and longer engagement with tasks

in the choice condition when difficulty increased for two out of four participants in (Skerbetz and Kostewicz 2015).

Similar to studies with adult participants, studies with neutral findings concluded that results were comparable and undifferentiated between conditions, as opposed to showing preference for the no choice condition. In spite of the undifferentiated outcomes between no choice and choice conditions, Lerman et al. (1997) and Mintz et al. (2007) did report some improvement in on-task behaviour in the choice condition when comparing it to a baseline.

Diagnosis Categories were classified according to diagnosis, recognised conditions or educational needs of the majority of their participants. Studies including samples with a variety of different disabilities (e.g. Liso 2010; Romaniuk et al. 2002) were included for analysis in the category of moderate to severe learning disabilities and various or non-specified disabilities. Of the six studies containing neurotypical participants, four found choice to be favourable according to particular factors (Ackerlund Brandt et al. 2015; Fenerty and Tiger 2010; Rost et al. 2014; Tiger et al. 2006). The two remaining studies (Brigham and Sherman 1973; Schmidt et al. 2009) reported that, overall, participants preferred the choice-making conditions.

From 13 studies investigating the effects of choice on participants with autism spectrum disorders including pervasive developmental disorders (PDD), eight studies showed overall positive results (Carlson et al. 2008; Geckeler et al. 2000; Humenik et al. 2008; Rispoli et al. 2013; Thompson et al. 1998; Toussaint et al. 2016; Ulke-Kurkcuoglu and Kircaali-Iftar 2010; Watanabe and Sturmey 2003), three showed results favourable according to particular factors (Kautz et al. 2018; Sellers et al. 2013; Tiger et al. 2010), and two reported neutral outcomes (Elliott and Dillenburger 2016; Harding et al. 2002).

The nine studies containing participants with moderate to severe learning disabilities or various other non-specified disabilities presented the most varied results. One of these studies showed positive results for choice conditions (Stenhoff et al. 2008); four found choice to be favourable according to particular factors (i.e. although choice was preferable to or not differentiated from a no choice condition, if it allowed participants to access highly preferred items, choice conditions providing access to lower preference stimuli were less preferred than no choice conditions providing access to higher preference stimuli) (Bambara et al. 1994; Dyer et al. 1990; Romaniuk et al. 2002; Parsons et al. 1990); three reported that the choice condition produced no differential effects (Lerman et al. 1997; Liso 2010; Smith et al. 1995), and finally one study showed mixed results with positive effects for only one out of two participants (Lane et al. 2015).

Studies with samples diagnosed with EBD or ADHD were mostly positive, with four showing overall reductions in problem behaviour and increases in on-task behaviour during choice conditions (Dunlap et al. 1994; Kern et al. 2001; Powell and Nelson 1997; Skerbetz and Kostewicz 2013), two studies showing increases in on-task behaviour under certain conditions (Fisher et al. 1997; Ramsey et al. 2010) and one study reporting mixed results (Skerbetz and Kostewicz 2015). Mintz et al. (2007) were the only study from this category reporting neutral results, stating that 'all four methods (teacher generated, student generated, teacher choice, and student choice) were effective in increasing responding' (p. 339). As observed with previous studies reporting neutral findings, these results do not suggest that choice conditions reduce responding or are less preferable than no choice conditions; they merely indicate undifferentiated responding.

A final two studies contained participants with traumatic brain injury (Tasky et al. 2008) and severe dementia (Engstrom et al. 2015). Both of these studies showed improvement in engagement for all participants.

Research Design Designs used across the 38 studies included reversal, multiple baseline, alternating treatments, concurrent chains and multicomponent designs. Toussaint et al. (2016) used a concurrent chains procedure to assess preference for choice, as well as a multicomponent design to examine the effects of choice in relation to on-task behaviour. Harding et al. (2002) also employed both a reversal design and a concurrent chains procedure.

Out of 13 studies using a reversal design, eight reported that choice conditions positively affected the dependent variables overall (e.g. Dunlap et al. 1994; Humenik et al. 2008; Kern et al. 2001; Powell and Nelson 1997; Skerbetz and Kostewicz 2013), four reported choice as favourable according to particular factors (Dyer et al. 1990; Kautz et al. 2018; Ramsey et al. 2010; Romaniuk et al. 2002), and one reported neutral results (Harding et al. 2002).

Similarly, out of 11 studies using a variation of a concurrent chains procedure, four showed choice to be preferred by the majority of participants regardless of outcomes (Brigham and Sherman 1973; Schmidt et al. 2009; Thompson et al. 1998; Toussaint et al. 2016), six found that participants selected choice dependent upon factors such as relative preference of items (Ackerlund Brandt et al. 2015; Fisher et al. 1997; Tiger et al. 2006), quality or magnitude of reinforcer (Rost et al. 2014; Sellers et al. 2013), and whether participants were offered task or consequence choice (Fenerty and Tiger 2010), and one reported neutral results (Harding et al. 2002).

Out of five studies employing an alternating treatment design, two showed choice to be favourable according to particular factors (Bambara et al. 1994; Parsons et al. 1990), one showed mixed results (Skerbetz and Kostewicz 2015), and two neutral results (Elliott and Dillenburger 2016; Liso 2010).

The nine studies using multicomponent designs had the most varied results, with four presenting overall positive results (Engstrom et al. 2015; Geckeler et al. 2000; Rispoli et al.

2013; Toussaint et al. 2016), one showing that results were dependent upon the reinforcement schedule in effect (Tiger et al. 2010), three presenting neutral results (Lerman et al. 1997; Mintz et al. 2007; Smith et al. 1995), and one mixed (Lane et al. 2015).

Watanabe and Sturmey (2003) and Carlson et al. (2008) conducted the only two studies to use a standalone multiple baseline design. Their results showed that choice positively affected on-task behaviour for all participants.

Dependent Variables

The dependent variables addressed in the selected studies were divided into three categories: on-task behaviour, problem behaviour and selection of a choice condition compared with a no choice condition.

On-Task Behaviour Overall, 16 studies measured features of on-task behaviour as dependent variables (e.g. Elliott and Dillenburger 2016; Liso 2010; Ramsey et al. 2010; Skerbetz and Kostewicz 2013).

Under half of the studies measuring on-task behaviour (six out of 17) found that on-task behaviour was higher for all or a majority of participants in the choice condition (e.g. Engstrom et al. 2015; Skerbetz and Kostewicz 2013; Stenhoff et al. 2008; Tasky et al. 2008). Results showed choice to be favourable according to particular factors in five studies. Bambara et al. (1994) found that engagement was highest in both the assigned high preference and choice conditions and lowest in the assigned low preference condition. Ramsey et al. (2010) found that choice of task sequence increased time on-task and improved task completion rates but did not have the same effect on accuracy (although accuracy did increase during the choice condition, it did not to the degree of the other dependent variables). Tiger et al. (2010) found that on-task behaviour altered depending upon the reinforcement schedule in effect while Parsons et al. (1990) found that on-task behaviour was comparable between choice and high preference assigned tasks and lowest during low preference assigned tasks. Skerbetz and Kostewicz (2015) reported mixed results, finding that, although no difference was detected in on-task behaviour during conditions when participants were working independently, as task difficulty increased, two of the four participants engaged for longer in the choice conditions. Five studies reported neutral findings, showing that participants were no more engaged (Liso 2010) or produced no more responses (Elliott and Dillenburger 2016; Lerman et al. 1997; Mintz et al. 2007; Smith et al. 1995) in the choice condition than the no choice condition.

Problem Behaviour A total of six studies focused solely on the effects of choice on problem behaviour (Carlson et al. 2008; Harding et al. 2002; Humenik et al. 2008; Powell and Nelson 1997; Rispoli et al. 2013; Romaniuk et al. 2002). Four studies found overall positive results with problem behaviour reducing within choice conditions (Carlson et al. 2008; Humenik et al. 2008; Powell and Nelson 1997; Rispoli et al. 2013), while Romaniuk et al. (2002) showed 'substantial reductions' in escape-maintained problem behaviour but no differential outcomes for problem behaviour maintained by attention (p. 356) and Harding et al. (2002) reported neutral results.

Five of the studies with problem behaviour as the dependent variable used a functional assessment to determine the function of the problem behaviour. Carlson et al. (2008) used both indirect and descriptive functional assessment methods, Humenik et al. (2008) and Rispoli et al. (2013) used indirect assessments, while Harding et al. (2002) and Romaniuk et al. (2002) conducted a functional analysis. Humenik et al. (2008) found that the participant's self-injurious behaviour was maintained by escape, to a lesser degree by attention and, at times, by automatic consequences (p. 19). Rispoli et al. (2013) found escape to be the function of problem behaviour. Romaniuk et al. (2002) found problem behaviour to be maintained by escape for three participants, attention for a further three participants and both escape and attention for a final participant. Harding et al. (2002) identified escape and tangible as the primary functions of problem behaviour for both participants. Carlson et al. (2008) identified that public disrobing was maintained by access to tangibles. In terms of results, Rispoli et al. (2013) found that choice of activity resulted in a decrease in problem behaviour (p. 77), while Humenik et al. (2008) found choice-making to be effective in reducing self-injurious behaviour (p. 20). Results from Romaniuk et al. (2002) similarly showed reductions in behaviour which was maintained by escape, although interestingly found no difference in attention-maintained behaviour between conditions (p. 357). Carlson et al. (2008) concluded that offering choice resulted in a decrease in problem behaviour. Although a limited sample of studies, there is a possibility that the effectiveness of choice interventions to reduce problem behaviour may be limited depending upon the function which that behaviour serves and this is an area which may benefit from further study.

On-Task Behaviour and Problem Behaviour Five studies measured the effects of choice conditions on both on-task and problem behaviour (Dunlap et al. 1994; Dyer et al. 1990; Kautz et al. 2018; Kern et al. 2001; Lane et al. 2015). Dunlap et al. (1994) and Kern et al. (2001) showed increased on-task behaviour and decreased problem behaviour for all participants. Although it may be hypothesised that if choice interventions result in a decrease of problem behaviour then on-task behaviour will necessarily increase, some studies suggest that this may not be the case. Dyer et al. (1990) showed that choice conditions resulted in a reduction of problem behaviour

but 'no effect on the rate of responding on the instructional tasks' (p. 519). Kautz et al. (2018) reported that choice of the task sequence did not impact task engagement but for two participants, it reduced non-compliant behaviour. Lane et al. (2015) showed increases in on-task behaviour and decreases of problem behaviour during choice condition for one participant and, while the other did show an increase in engagement, no functional relation was detected.

Lane et al. (2015) and Dyer et al. (1990) both mentioned possible functions for the problem behaviours addressed, while Kautz et al. (2018) noted that future research should determine function. Only Kern et al. (2001) conducted an experimental functional analysis to determine the function. Although Kern et al. (2001) showed positive results overall, of the participants found to display escape-maintained problem behaviour, one participant showed substantial decreases in the choice condition while the second participant showed reduced problem behaviour in the no choice condition. Hypotheses are offered as to why problem behaviour may have decreased in the no choice condition, for example, that additional procedures such as extinction were in place but this study signifies, again, that there is a need to further address the relation between choice interventions and problem behaviour maintained by different functions.

Responses Showing Preference This category encompasses studies which compared preference for choice using a concurrent schedule arrangement (or a modified version thereof). This category includes dependent variables such as frequency of selection of an option (Ackerlund Brandt et al. 2015), response rate (Geckeler et al. 2000), time spent in a particular component or responses allocated to one option over another (Fisher et al. 1997).

Out of 11 studies in total, five showed choice to be overall positive for a majority of participants (Brigham and Sherman 1973; Geckeler et al. 2000; Schmidt et al. 2009; Thompson et al. 1998; Toussaint et al. 2016), with Schmidt et al. (2009) and Thompson et al. (1998) highlighting that choice was preferred even when it resulted in access to less preferred stimuli. All remaining studies found choice to be favourable according to particular factors, e.g. participants preferred consequence choice but did not show preference for task choice over no choice conditions (Fenerty and Tiger 2010) or choice was preferred with equal stimuli but preference for choice decreased when the no choice conditions allowed access to higher preference stimuli (Ackerlund Brandt et al. 2015; Fisher et al. 1997; Rost et al. 2014; Tiger et al. 2006). Sellers et al. (2013) concluded that possible influences over preference for choice may include 'stimulus variation, higher quality reinforcement, and choice-making opportunities' (p. 462).

Independent Variables

Antecedent Choice and Consequence Choice From included studies, 20 examined antecedent choice, 16 considered consequence choice, and two studies considered choice as both consequence and antecedent measures.

When considering choice of task or activity, 12 studies showed overall positive results for choice (e.g. Carlson et al. 2008; Dunlap et al. 1994; Humenik et al. 2008; Kern et al. 2001) while five studies showed choice was favourable according to particular factors (Bambara et al. 1994; Kautz et al. 2018; Parsons et al. 1990; Ramsey et al. 2010; Romaniuk et al. 2002). One study (Lane et al. 2015) showed mixed results and a further two studies (Harding et al. 2002; Liso 2010) presented neutral results. Overall, 17 out of 20 studies examining antecedent choice (85%) showed superiority of choice conditions.

Of the studies considering choice of reinforcement, five studies found that choice was preferred or positively affected the dependent variables overall (e.g. Brigham and Sherman 1973; Geckeler et al. 2000; Schmidt et al. 2009; Thompson et al. 1998; Toussaint et al. 2016). A further six studies found choice to be favourable according to particular factors, such as when reinforcement was highly preferred in both conditions (e.g. Rost et al. 2014; Tiger et al. 2006). One study presented mixed results (Skerbetz and Kostewicz 2015) and four studies found that choice was no more preferred or had no differential effect on the dependent variable than no choice conditions (Elliott and Dillenburger 2016; Lerman et al. 1997; Mintz et al. 2007; Smith et al. 1995). Overall, 11 out of 16 studies (68%) showed that choice condition was superior.

Two studies considered or compared both choice of reinforcement and choice of task and both found choice to be favourable according to particular factors. Dyer et al. (1990) found that both antecedent and consequence choice conditions reduced disruptive behaviour but had no differential effect on accuracy (p. 519). Results from Fenerty and Tiger (2010) showed that the consequence choice condition was preferred by three of the four participants but no participants showed preference for the task choice condition over the no choice condition.

Yoking Procedures Some studies assessed the relative value of different reinforcers through the use of preference assessments and then yoked stimuli to highly preferred options from the choice conditions. Others have considered whether participants prefer choice conditions even when these result in a less preferred option than a no choice condition. Yoked no choice conditions, where stimuli were matched to those chosen in the choice condition, were used in nine of the studies. The yoking procedures varied from yoking one of the no choice phases to the stimuli chosen in a previous phase (Dunlap et al. 1994; Sellers et al. 2013; Tasky et al. 2008), yoking the no choice

condition for just one participant due to the consistency of their choices (Kern et al. 2001), and yoking all no choice conditions (Fisher et al. 1997; Humenik et al. 2008; Lerman et al. 1997; Toussaint et al. 2016).

Among studies employing yoking procedures, five reported overall positive results, with three studies containing results indicating variations according to other factors (Fisher et al. 1997; Kautz et al. 2018; Sellers et al. 2013) and one study presenting neutral outcomes. When contrasting these results with overall results across 38 studies in order to reach conclusions on whether yoking procedures yield differential outcomes, we observe that approximately 56% of yoked studies showed overall positive results compared with 45% of total studies, 33% of yoked studies showed choice to be favourable according to particular factors compared to 34% of total studies, 11% of yoked studies reported neutral results compared to 16% of total studies and no yoked studies showed mixed results compared to 5% of total studies. This suggests that yoking procedures may help ensure higher internal validity, which in turn produces robust differentiating results (i.e. fewer studies report neutral or mixed outcomes).

Synthesis of Results

Overall (Fig. Fig. 3), results indicate that in 17 studies (45%), choice was preferred or had a beneficial impact for all or the majority of participants. Seven of these studies contained two or more participants and determined that preference for choice led to positive outcomes for all participants. A further 13 studies (34%) indicated that choice conditions were favourable according to particular factors. For example, choice conditions may have positively affected one dependent variable but not another (e.g. choice conditions resulted in improved engagement but no difference in accuracy), may have been preferred to one condition but less preferred than another (e.g. choice conditions involving high preference stimuli were preferred when no choice conditions also offered high preference stimuli but were not preferred when no choice conditions offered a more highly preferred stimulus than the choice condition), or choice may have been more or less preferred dependent upon which various features of the stimuli were altered. Mixed results were found in two studies (5%), while six studies (16%) reported neutral results with the dependent variable not being affected by choice conditions. It is interesting to note that the studies producing neutral results detected minimal differences between conditions and confirmed that responding remained high across conditions.

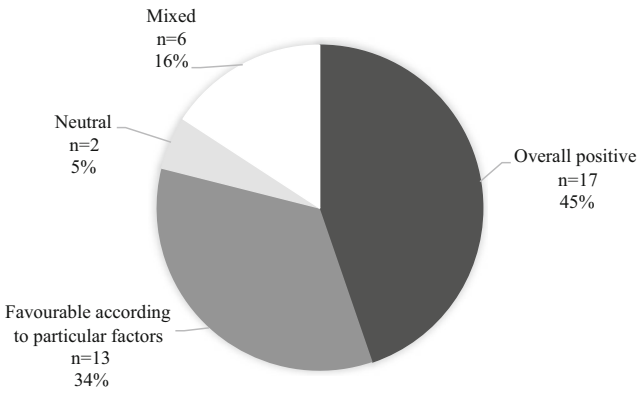

Fig. 3 Overview of results across 38 studies

Quality Assessment Results

Results of the quality assessment are contained in Table 1. In sum, 17 studies were determined to be of strong design quality, with 21 studies falling into the moderate category. No studies were determined to possess a weak design quality. Only three studies contained statistical analyses of data (Lane et al. 2015; Rispoli et al. 2013; Rost et al. 2014) and, of the 38 studies, only 11 included a minimum of five data points for each participant in each condition.

Discussion

Preference for Choice

Results from studies included in this review indicate that the three research questions are addressed in summation by concluding that, under particular circumstances and dependent upon certain factors, choice is preferred and may effectively result in an increase of on-task behaviour and reduction of problem behaviour. When ensuring access to stimuli of equal preference across choice and no choice conditions, results show that most individuals would prefer to be offered a choice rather than be assigned or provided with a task or reinforcer chosen by somebody else.

Studies which further examine preference for choice by comparing a choice condition with lower preference stimuli against a no choice condition with higher preference stimuli suggest that many individuals may prefer a no choice condition if this allows them access to higher preference stimuli (Bambara et al. 1994; Fisher et al. 1997; Parsons et al. 1990; Rost et al. 2014). In contrast, other studies show unexpected results suggesting that the preference for choice may differ from individual to individual. For example, Thompson et al. (1998) showed that, for one child, preference for choice was shown 'even when it resulted in a much less favourable rate of reinforcement (up to 4000% less), suggesting that his preference for choice was rather excessive' (p. 185). Contrary to this, Tiger et al. (2006) found that one participant showed consistent preference for no choice over the choice condition until the array of items was increased to 10 during the choice link, at which point responding was similar across both conditions (p. 11). The authors identified that this outcome was

unusual, noting that 'a preference for no choice conditions when the consequence for choice and no choice selections were matched... have not been demonstrated in prior research' (p. 7). These contrasting results indicate that, although unusual, some individuals do show extreme preference for choice or no choice regardless of the features of reinforcement. It seems likely that, as Sellers et al. (2013) suggest, the act of choice-making is complex and individuals may respond in various ways to different parts of the process. There might be a possibility that there is a point at which preference for choice is overridden by the likelihood of access to preferred stimuli. Tiger et al. (2006) also found that, for one participant, when the number of items increased in the choice condition, that condition was almost 'exclusively selected' (p. 9). Results from the present systematic review suggest that the point at which preference for choice diminishes may differ for each individual depending on the outcome of that choice.

Studies suggesting that choice is preferred when it allows access to more highly preferred stimuli may provide more positive evidence for choice interventions than on first consideration. As Cannella et al. (2005) identified, preference might change over time; therefore, offering choice ensures that changing preferences are captured. This benefit is most effective when choice is presented and made closely in time to the point where the individual accesses the item. Allowing an individual to choose a task or reinforcer at the moment of or shortly before the point of access increases the likelihood of ongoing motivating operations being captured (Langthorne and McGill 2009). An assigned stimulus which has been identified by an earlier preference assessment or selected by a third party may possess a reducing value to the individual due to changing motivating operations; this holds true especially for stimuli that easily produce satiation, such as edibles, but is applicable to various stimuli and activities.

Regarding studies with neutral or mixed results, it is important to highlight that no studies reported negative effects of choice. Indeed, some studies found that, although there was no difference between conditions, responding increased for most participants compared to a no reinforcement baseline (Lerman et al. 1997; Mintz et al. 2007; Smith et al. 1995). Liso (2010) assessed engagement during a child selected (choice) condition and an adult selected (no choice) condition and found engagement did not differ between these two conditions. Lane et al. (2015) reported mixed results, identifying that choice of task resulted in an increase in engagement and reduction of problem behaviour for one only of the two participants. In turn, Skerbetz and Kostewicz (2015) found no difference between conditions when simple tasks were presented but noted a superiority of the choice condition for two students as task difficulty increased. As Lancioni et al. (1996) recognised, undifferentiated responding between choice and no choice conditions should not preclude practitioners from offering choice, given antecedent or consequence choice is unlikely to negatively affect responding and may have beneficial effects for participants, even if these are not always as significant as to become detectable under experimental conditions.

Preference for Choice According to Diagnosis

These results suggest that trends may vary in line with the individual's diagnosis. In our review, the largest number of overall positive results for choice were observed with participants with ASD including PDD, for whom choice was preferred or beneficial compared to at least one other condition and for at least one dependent variable. This outcome suggests that offering choice may be a particularly effective intervention for increasing on-task behaviour and reducing problem behaviour in children with ASD. These findings are consistent with findings of a previous systematic review focusing specifically on the effect of choice on academic performance of children with ASD (Reutebuch et al. 2015).

Neurotypical participants also appeared to show positive results regarding preference for choice with no studies containing neutral or mixed results. Studies including participants with moderate to severe learning disabilities or non-specified disabilities appeared to be the most varied in terms of results, making it difficult to draw conclusions. In general terms, we can claim that choice also benefits individuals with other disabilities, given half of studies in this category evidenced better outcomes for choice condition.

Studies containing participants with EBD or ADHD, as well as studies with participants with dementia or brain injury, reported choice conditions to be superior to no choice condition, with only two studies reporting mixed (Skerbetz and Kostewicz 2015) or neutral results (Mintz et al. 2007). This outcome has implications for further research or practice with individuals with disabilities in general, suggesting that choice interventions may be beneficial for individuals who would otherwise have difficulty remaining on-task or who engage in problem behaviour.

Overall, the variation in age and diagnosis of participants suggests that offering choice is relevant to a wide range of individuals and circumstances. As some of the authors of included studies have already recognised, choice might be more or less beneficial according to individual factors (e.g. Cannella et al. 2005) but generality in positive outcomes apparent in choice conditions suggest that offering individuals the freedom to choose should be standard practice rather than a fix for decreased on-task behaviour or increased problem behaviour.

Comparison of Antecedent Choice and Consequence Choice

Only two of the studies included in this review considered both antecedent and consequence choice (Dyer et al. 1990;

Fenerty and Tiger 2010), with one directly comparing the two conditions. Dyer et al. (1990) showed that offering choice led to a decrease in problem behaviour even though the items participants chose were the same as those administered by adults in the no choice condition. The authors of this study suggest that offering choice might be more effective than preference assessments in capturing changing preferences. Fenerty and Tiger (2010) conducted the only study included in this review to directly compare task choice with consequence choice. In this, participants were asked to choose an initial link leading to either a control condition, a no choice condition, a task choice condition (choice of task and adult delivered reinforcer) or a reinforcer choice condition (adult delivered task and choice of reinforcer). Results showed that three of the four participants selected the consequence choice condition the most often, while the task choice condition was equally preferred to the no choice condition for all participants. While a single study cannot lead to definite conclusions, this outcome is a signpost for a need for further research.

When considering all 38 studies reviewed in this synthesis, a slightly higher percentage of studies examining consequence choice presented neutral or mixed results (31%) than those considering antecedent choice (15%). In contrast, studies examining antecedent choice presented predominantly positive results (85%), while a slightly lower percentage of studies examining consequence choice (69%) showed superiority of the choice condition. Although these differences in percentages do not indicate significantly different results, they suggest a need for further refining methodological robustness, especially of studies examining consequence choice. An attempt to overcome methodological limitations has become evident in the use of yoking procedures; however, the ability of these to capture changing motivating operations might still be somewhat limited (Kern et al. 2001; Schmidt et al. 2009).

Limitations

In this systematic review, measures were taken to avoid bias; however, it is still likely that some relevant studies might have been missed due to searches using particular keywords. We believe this risk has been minimised by using variations for choice. The possibility of publication bias is a further limitation of any review, given studies with positive results are more likely to be published. Additionally, the use of the umbrella term *on-task* that embraces a number of different behaviours might have hidden relevant findings in eligible studies and consequently in the present review.

The quality assessment indicated that less than half of studies possess strong quality evidence, with the other half being rated as moderate. This outcome suggests that conclusions should be examined with caution. Additionally, as included studies use variations of single-subject research designs, we have to recognise that due to sampling variations, studies with small samples provide lower validity than those with larger samples (Higgins and Green 2011). The frequent use of convenience rather than randomly selected samples in single-subject research designs might also result in a potential bias.

Conclusions and Recommendations

Our results have direct implications for practice. A behavioural intervention that includes choice is quick and easy to implement, requires no special resources or training and benefits individuals, particularly those with disabilities, in terms of facilitating increased communication, accounting for changing preferences and allowing greater autonomy. As Kern et al. (1998) observed, individuals with disabilities have the right both to make choices and to learn the necessary skills that will allow them to choose. It is therefore recommended that strategies involving both antecedent and consequence choice are adopted where there may be a need for increasing on-task behaviour and reducing problem behaviour but also as a medium through which to teach individuals with disabilities a crucial life skill and to offer an education that is respectful of their autonomy (Bannerman et al. 1990). Clearly, both educational professionals and parents should teach individuals with disabilities the necessary skills to make a choice; for example, the skill to point to one out of many presented pictures to indicate favourite activity or the ability to vocally request for a preferred item. Choice should routinely be offered during everyday activities by asking individuals to choose which activities they wish to engage in, allowing them to choose the order in which to complete tasks or offering them a range of items from which to choose their favourites.

In terms of future research, efforts should be directed towards refining research methods that will produce credible results. An additional area to explore would be whether specific participant characteristics, such as age, diagnosis and level of functioning, serve as an indication of the best candidates for choice, therefore allowing practitioners to incorporate choice by default with certain populations. Other factors that might affect preference for choice, such as the value or amount of available stimuli, the immediate versus delayed access to stimuli, or the task difficulty, should also be explored for their impact on the design of teaching procedure that aim to increase on-task or decrease problem behaviour. Furthermore, assessing how problem behaviour maintained by particular functions (e.g. escape from tasks)

might affect preference for choice seems relevant and would add to our understanding of the conditions that would warrant choice to be offered. Last but not least, an outline of effective training methods for teaching individuals the necessary skills for making choices would serve as a guide for practitioners aiming to incorporate choice as a default procedure.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval This article does not contain any studies with human participants or animals performed by any of the authors.

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