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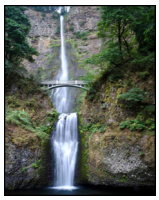

A meta-analysis of factors related to recycling

Josefine L. Geiger[a,b,*], Linda Steg[b], Ellen van der Werff[b], A. Berfu Ünal[b]

[a] Top Institute Food and Nutrition, P.O. Box 557, 6700, AN, Wageningen, the Netherlands
[b] Psychology, University of Groningen, Grote Kruisstraat 2/1, 9712, TS, Groningen, the Netherlands

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ABSTRACT

The current meta-analysis aimed to identify the most important factors related to recycling across studies. A random-effects meta-analysis of studies on individual and household recycling (n = 91) revealed that both individual and contextual factors are related to recycling. Among individual factors, behaviour-specific factors (i.e., recycling self-identity, personal norms towards recycling, past recycling, and perceived behavioural control over recycling) were better predictors of recycling than general factors (i.e., general knowledge, general attitudes, general personal norm). Among contextual factors, the possession of a bin at home and house ownership were particularly predictive of recycling. Moreover, individual and contextual factors better predicted intention to recycle than self-reported recycling behaviour, and particularly than observed recycling behaviour. We discuss the theoretical and practical implications of our findings. We indicate that future studies could more systematically examine the effects of contextual factors on recycling, as well as the interplay of individual and contextual factors.

1. Introduction

Across the globe, we produce approximately 1.3 billion tonnes of waste per year, and the production of waste is increasing (Hoornweg & Bhada-Tata, 2012). Most of this waste still goes to landfills or dumping sites (Hoornweg & Bhada-Tata, 2012), while only a small percentage is recycled. In 2012, for example, only 29% of the municipal waste was recycled and composted in the European Union (European Environment Agency, 2015). As recycling enables the retrieval of secondary raw materials and thereby reduces greenhouse gas emissions (Corsten, Worrell, Rouw, & Van Duin, 2013; European Union, 2014), encouraging recycling is critical to address today's waste problems. Important players, such as the European Union and the Worldbank, have put the goal to increase recycling rates on their agendas for the near future. To design effective strategies to promote recycling, it is critical to understand which factors determine individual and household recycling.

We define recycling as individuals' waste collection intentions and behaviour to allow materials to be re-used. Various studies have examined the effects of different strategies to promote recycling. A recent meta-analysis systematically synthesized this literature and found social modelling and environmental alterations to be the most effective interventions (Varotto & Spagnolli, 2017). Their meta-analysis assessed interventions to promote recycling. Yet, a synthesis of the literature on individual and contextual factors influencing recycling is lacking, despite a growing number of studies that have examined factors influencing recycling over the last two decades. The growing number of studies highlights the great interest in understanding which factors influence recycling. Whereas these studies have provided important insights in which factors are related to recycling in a particular context, little is known about robust predictors of recycling across studies and contexts. Notably, studies on recycling have focused on a variety of predictors, relying on different methodologies to explain recycling. This large and diverse literature on factors predicting recycling implies a challenge to integrate scattered findings on important factors influencing recycling. In response to this, we aim to conduct a meta-analysis to classify the most robust and important predictors of recycling across studies. A meta-analysis allows researchers to systematically review and synthesize the literature on recycling, thereby assessing the magnitude of the association between different predictors and recycling.

1.1. Predictors of recycling

This meta-analysis considers a wide range of factors that have been included in studies aimed to understand recycling. Specifically, the factors included can be classified into two main categories: individual factors and contextual factors. Individual factors include, amongst

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* Corresponding author. Top Institute Food and Nutrition, P.O. Box 557, 6700, AN, Wageningen, the Netherlands.
E-mail address: j.l.geiger@rug.nl (J.L. Geiger).

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others, attitudes, social norms (i.e., descriptive and injunctive norms), perceived behavioural control, personal norms, values, and anticipated affect. Most of these individual factors have been included in prominent theories to explain environmental behaviour, such as the Theory of Planned Behaviour (Ajzen, 1991), the Norm-Activation-Model (Schwartz & Howard, 1981), and the Value-Belief-Norm theory on environmentalism (Stern, 2000), but only a few studies have tested these theories explicitly. Furthermore, the individual factors have been operationalized at different levels of specificity. More specifically, individual factors have been conceptualised either at a behaviour-specific level, focusing on recycling, or at a more general level, reflecting environmental considerations or beliefs and norms regarding environmental behaviour in general.

Contextual factors reflect the circumstances in which recycling takes place. These include local circumstances (e.g., recycling facilities in the neighbourhood, possession of a recycling bin) and the housing situation (e.g., type of house).

We aim to examine the extent to which these different individual and contextual factors predict recycling. A meta-analysis by Hornik, Cherian, Madansky, and Narayana (1995) on recycling revealed that individual factors were somewhat more strongly related to recycling than contextual factors. We extend their study by including studies that were conducted in the more than 20 years after their meta-analysis and by considering both specific and general individual factors, as well as contextual factors, and to identify the most robust and important predictors of recycling.

In the following, we will introduce the different individual factors that have been examined to understand recycling. Some of these individual factors have been conceptualised at a specific level, referring to recycling directly, while others have been conceptualised at the general level, referring to the environment or environmental behaviour. Next, we introduce contextual variables that have been examined in studies that aimed to understand recycling. We discuss the individual factors and contextual factors, respectively, in alphabetical order.

1.1.1. Individual factors

Anticipated affect reflects the extent to which individuals anticipate recycling will elicit different feelings. Anticipated affect proved to be an important predictor of various types of pro-environmental behaviour, next to the cognitive factors we discuss below (Gatersleben & Steg, 2012). The more people anticipate positive feelings about engaging in certain behaviour, the more likely they are to engage in this behaviour (Taufik, Bolderdijk, & Steg, 2016), while anticipated negative feelings may inhibit the relevant behaviour (Carrus, Passafaro, & Bonnes, 2008). Therefore, we expect that people are more willing to recycle when they anticipate that recycling will elicit positive feelings (rather than negative feelings).

Attitudes towards recycling reflect the extent to which people evaluate recycling favourably (cf. Ajzen, 1991), which depends on expected costs and benefits of recycling (Ajzen, 1996), including environmental costs and benefits of recycling (which is sometimes referred to as awareness of the environmental consequences of recycling). Overall, the more positive one's attitudes towards a behaviour such as recycling, the more one is likely to engage in this behaviour. *Environmental attitudes or beliefs* reflect the extent to which an individual is concerned about the environment in general (Steg, de Groot, Dreijerink, Abrahamse, & Siero, 2011). Environmental attitudes have often been conceptualised as the New Environmental Paradigm (NEP; Dunlap, Van Liere, Mertig, & Jones, 2000), reflecting people's general beliefs on the relationship between humans and nature and the environment. Next, environmental attitudes have been conceptualised as awareness of the environmental consequences of behaviours. Environmental attitudes appeared to be positively related to a variety of pro-environmental behaviours (Steg et al., 2011). Therefore, we expect that the stronger one's environmental attitudes, the more likely people are to engage in recycling.

A *descriptive* norm *to engage in recycling* reflects the extent to which people think that other people recycle their waste, while a *descriptive* norm *to engage in pro-environmental behaviour* reflects the extent to which people believe that other people engage in pro-environmental behaviour in general. People are motivated to act in line with descriptive norms, thus to act in line with behaviour that is common, as descriptive norms reflect what is the most adaptive or correct behaviour in a given situation (Keizer & Schultz, 2012). Based on this, we expect that individuals are more likely to recycle their waste when they believe that many other people do recycle, or engage in pro-environmental behaviour in general.

Injunctive norms are conceptualised as individuals' perceptions of the extent to which others would approve or disapprove certain behaviours (cf. Cialdini & Trost, 1998), such as recycling, or pro-environmental behaviour in general. Complying with an injunctive norm is expected to yield social approval and rewards, while not following injunctive norms is likely to lead to social disapproval and punishments. Consequently, we expect that the more one experiences a favourable *injunctive* norm *towards recycling* or a favourable *injunctive* norm *towards pro-environmental behaviour* in general, the more likely one is to recycle.

Knowledge about recycling reflects the extent to which people know how to recycle their waste. *Knowledge about environmental problems* reflects the extent to which people know about the causes and consequences of environmental problems, or know which behaviours cause such problems (cf. Schultz, 2002). Overall, higher knowledge, both at the specific and at the general level, is likely to lead to more recycling. In particular, we expect people to be more likely to recycle their waste when they know how to do so (Schultz, Oskamp, & Mainieri, 1995). Furthermore, a person with more knowledge about environmental problems will be more likely to recycle than a person who has little knowledge about environmental problems (cf. Kaiser & Fuhrer, 2003).

Past recycling has been included as a predictor of recycling in various studies. Past behaviour has been only operationalized at the specific level, referring to past recycling. Past recycling may lead to a habit to recycle (cf. Verplanken & Aarts, 1999). If people have a recycling habit, they may engage in recycling automatically, without making a conscious decision about it anymore. The more individuals recycled in the past, the more likely it is they have developed a recycling habit, the more likely they are to recycle in the future as well.

Perceived behavioural control is defined as the degree to which an individual perceives him or herself as being able to engage in a certain behaviour. Perceived behaviour control can be conceptualised with regard to recycling behaviour specifically, as well as to pro-environmental behaviour in general (cf. Ajzen, 1991). Perceived behavioural control has also been conceptualised as self-efficacy (Tabernero, Hernandez, Cuadrado, Luque, & Pereira, 2015), which reflects the extent to which individuals believe they are able to recycle or engage in pro-environmental behaviour. The higher one's perceived behaviour control to recycle and to engage in pro-environmental behaviour, and the higher their perceived self-efficacy to do so, the more likely people would be to engage in recycling.

Personal norms towards a particular behaviour reflect feelings of moral obligation to engage in this behaviour, and serve as internalized moral rules or standards for one's own behaviour (cf. Kallgren, Reno, & Cialdini, 2000). People are motivated to act in line with their personal norms to be able to feel good about themselves, and to prevent feelings of guilt. Personal norms have been conceptualised at the specific level, reflecting personal norms to recycle, as well as at the more general level, that is, personal norms to engage in pro-environmental behaviours. We expect that stronger personal norms towards recycling as well as to engage in pro-environmental behaviour are related to more recycling.

Self-identity reflects the way individuals describe themselves (Cook, Keer, & Moore, 2002). A *recycling self-identity* reflects the degree to which a person sees him or herself as a person who recycles his or her waste (Nigbur, Lyons, & Uzzell, 2010), whereas *environmental self-*

identity describes the extent to which people see themselves as an environmentally friendly person in general (Van Der Werff, Steg, & Keizer, 2013a; Van Der Werff, Steg, & Keizer, 2013b). The stronger one's environmental self-identity, the more likely it is that people engage in pro-environmental behaviour, as well as in specific pro-environmental behaviours such as recycling (Van der Werff et al., 2013a, 2013b). Individuals are motivated to act upon how they see themselves as they aim to be or to appear consistent (Kashima, Paladino, & Margetts, 2014). Thus, we expect a person with a stronger recycling or environmental self-identity to recycle more than a person with a weaker self-identity.

Values are desirable *trans*-situational goals that reflect what people find important in life in general (Feather, 1995; Schwartz, 1992). Values are relatively stable and general guiding principles for individuals that may affect a wide range of pro-environmental behaviours, including recycling (e.g., Dietz, Fitzgerald, & Shwom, 2005). Particularly biospheric values, reflecting that people aim to benefit nature and the environment, appeared to be predictive of pro-environmental actions (De Groot & Thøgersen, 2012). Hence, we expect that individuals with stronger biospheric values are more likely to recycle than individuals with weaker biospheric values, as they are more likely to base their choices on the consequences of their behaviour for the environment (De Groot & Steg, 2007, 2008).

1.1.2. Contextual factors

Besides individual factors, contextual factors can affect recycling by facilitating or inhibiting recycling (Varotto & Spagnolli, 2017). In the following, we will introduce two types of contextual factors that can influence recycling.

Housing situation is conceptualised as the house type in which a person lives. Here, we explore two indicators of one's housing situation: ownership (own or rental house), and type of house (single-family house, apartment or detached houses). Research suggests that house-owners as well as individuals living in a single-family house recycled more than individuals living in a rented apartment (Oskamp et al., 1991). Similarly, higher recycling rates of metal were found among individuals living in single-family house than among individuals living in apartments (e.g., Hage, Söderholm, & Berglund, 2009). Ownership and type of house may affect the feasibility and practicality of recycling, which may affect the likelihood of recycling. We will explore whether the housing situation, in particular ownership and type of house, is related to recycling.

Local circumstances reflect the characterisation of the context in which recycling takes place. In this meta-analysis, we will explore four factors that may be relevant in this respect: the recycling facilities in the neighbourhood, the possession of a recycling bin at home, the distance to a recycling location, and the size of the neighbourhood. Studies have found that the possession of a recycling bin at home (e.g., Robertson & Walkington, 2009) as well as the availability of recycling facilities in the area positively influence recycling (e.g., D'Amato, Mancinelli, Zoli, 2016; Pearson, Dawson, & Breitkopf, 2012). Next, it was found that short distances to recycling facilities stimulated recycling (e.g., Hage et al., 2009; Schultz et al., 1995). Further, the size of the neighbourhood seems to affect recycling. Specifically, inhabitants of smaller neighbourhoods seemed to recycle more than inhabitants of bigger neighbourhoods (Derksen & Gartrell, 1993). Such local circumstances may influence the extent to which recycling is feasible and practical, thereby affecting recycling levels. We expect individuals to be more likely to recycle when the local circumstances facilitate recycling, that is, when individuals possess a recycling bin, when recycling facilities are in place in the neighbourhood, and when the distance to recycling facilities is short and the neighbourhood small.

1.2. Moderators

Extending previous research, we further aim to examine which variables moderate the relationships between different predictors and recycling, as to identify the conditions under which different individual and contextual factors are stronger or weaker predictors of recycling. First, we will examine whether the predictive power of individual and contextual factors depends on the operationalization of recycling. Recycling has been conceptualised as intended, self-reported, or observed recycling. We expect that the predictors are more strongly related to intention to recycle than to self-reported and observed recycling behaviour, as literature has typically shown an intention-behaviour gap, suggesting that motivation may not always translate into actual behaviour (Kollmuss & Agyeman, 2002). Second, we will examine whether the predictive power of factors explaining recycling differs across target groups, in particular students, households and employees in organisations. A common concern about using a student sample is the lack of representativeness and generalizability to the general population (Burkley & Blanton, 2017). In this meta-analysis, we aim to address this issue in the field of recycling by examining whether the magnitude of the association between different predictors and recycling differs across target groups.

In sum, we conducted a meta-analysis to identify individual and contextual factors that are related to recycling intentions, self-reported and observed behaviour across studies, and to examine the magnitude and consistency of these relationships. In doing so, and by considering a variety of predictors of recycling, this meta-analysis can have important implications for theory building as well as for practice; we elaborate on this in the discussion section.

2. Method

2.1. Literature search

We selected papers to be included in the meta-analysis via searches on the databases PSYCHInfo, Google Scholar, SCOPUS and Web of Science, and websites of journals that were most likely to publish studies on recycling (e.g., Journal for Environmental Psychology, Environment and Behavior, Journal of Applied Social Psychology, Journal of Resources, Conservation and Recycling); closing date was November 2016. Keywords were recycling (behaviour), (waste) sorting behaviour, collection behaviour, waste behaviour, and the combination of these. For an overview of the steps in the literature search process, please see Fig. 1. We then checked the reference lists of articles included in this meta-analysis for additional relevant papers. To get access to unpublished studies, we personally contacted four researchers whom we knew had conducted research on recycling. As a result, we received two additional studies that were included in this meta-analysis. Moreover, we sent a request for sending us unpublished studies via relevant mailing lists (notably the Environmental Psychology list, and the Virtual Community on Sustainability and Consumption list). On the basis of the latter, we received 13 additional studies, of which 6 were included in the meta-analysis. The other 7 studies that we received were not included, as they did not meet our inclusion criteria which we discuss below.

2.2. Inclusion criteria

The following criteria were used to select studies relevant for the current meta-analysis. First, we only included studies that examined recycling, operationalized in one of the following ways: observed, self-reported, or intended recycling. We selected studies that focused on general recycling as well as recycling of particular materials (e.g., plastics, paper). Second, we only included studies that examined recycling on the individual or household level. Third, studies had to report the statistics necessary to calculate the effect size of the relationships between individual and contextual factors and recycling. If relevant statistics were not reported, we contacted the authors and asked for the information missing. In total 24 researchers were

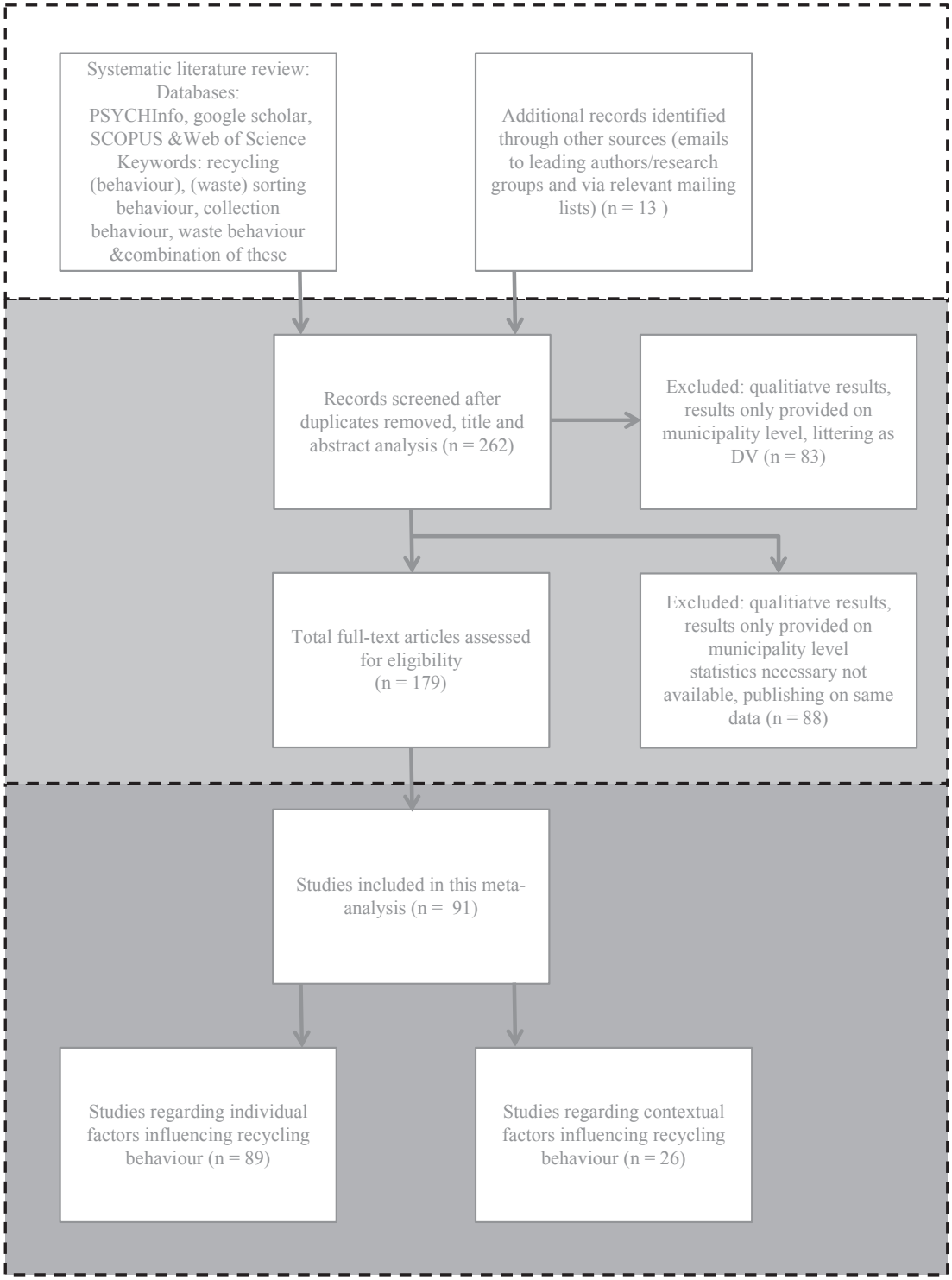

Fig. 1. Steps in the current meta-analysis' literature search process (following Moher, Liberati, Tetzlaff, & Altmann, 2009). *Note.* Of the 91 studies (86 papers) included, 24 studies included individual and contextual factors, 65 studies out of the 89 studies regarding individual factors only studied individual factors and 2 studies out of the 26 studies regarding contextual factors only studied contextual factors.

contacted, of which seven responded. Yet, only two of them provided the statistics necessary to include the study in the meta-analysis. The reason why the other five researchers could not provide the data requested was that the data was not accessible for them anymore (i.e., old data, researcher retired). We further had to exclude the paper by Tabernero and Hernández (2011) which was based on the exact same datasets as one other paper that had been already included in our analyses that was reported in a paper by Tabernero and colleagues (2015). This decision was based on the inspection of number of participants, mean age, gender distribution, country and year in which the studies were conducted. In this case, we included the study that provided most data on correlations between variables of interest in the analyses.

Table 5
Overview of studies included.

Author(s)	Country	Total N	Mean age	Gender – % female	Predictors	Operationalization of Recycling	Target group	Effect size& 95% CI
Aguilar-Luzón, Calvo-Salguero, and Salinas (2014)	ES	184	21.6	75	Anticipated affect, specific attitudes	I, S	ST	.18 [.04, .32]*
Aguilar-Luzón, García-Martínez, Calvo-Salguero, and Salinas (2012)	ES	120	50.6	100	Specific attitudes, specific injunctive norms, specific perceived behavioural control, specific and general personal norms, values,	I, S	H	.32 [.15, .47]**
Allen and Ferrand (1999)	US	98	NI	85	General perceived behavioural control	S	ST	.28 [.09, .45]**
Andersson and Von Borgstede (2010)	SE	418	45	55.1	Specific descriptive norms specific knowledge, specific personal norms,	S	H	.31 [.22, .40]**
Arbuthnot and Lingg (1975)	F	60	NI	NI	General knowledge, general perceived behavioural control	S	H	.11 [-.16, .36]
Arbuthnot and Lingg (1975)	U.S.	85	NI	NI	General knowledge, general perceived behavioural control	S	H	.32 [.15, .48]**
Barr (2001)	UK	673	NI	57	Environmental attitudes, bin, house type, specific and general knowledge	I, S	H	14 [.07, .21]**
Berger (1997)	CA	43000	NI	NI	Facilities, house type, ownership, size	S	H	.30 [.29, .31]**
Bertoldo & Castro (2015)	P, BR	331	P: 22.5, BR: 23.7	P: 59.2, BR: 47.4	Specific descriptive norms, general self-identity, specific injunctive norms, specific personal norms	S	ST	.05 [-.06, .16]
Bianchi and Birtwistle (2010)	UK	504	NI	100	Environmental attitudes	S	H	.26 [.18, .34]**
Bianchi and Birtwistle (2010)	AU	239	NI	100	Environmental attitudes	S	H	.26 [.13, .37]**
Boldero (1995)	AU	208	35.8	64.6	Specific attitudes and environmental attitudes, bin, specific and general injunctive norms, specific perceived behavioural control, size	S	H	.18 [.05, .30]**
Botetzagias, Dima, and Malesios (2015)	GR	293	NI	59.4	Specific attitudes, specific injunctive norms, specific perceived behavioural control, specific personal norms	I	H	.42 [.32, .51]**
Bratt (1999)	N	423	NI	NI	Specific injunctive norms, specific personal norms	S	H	.20 [.10, .29]**
Burn (1991)	U.S.	211	NI	NI	Specific descriptive norms, Specific knowledge	B	H	.23 [.09, .37]**
Carrus, Bonnes, Fornara, Passafaro, and Tronu (2009)	IT	303	40.4	50.2	General descriptive norms	I	H	.45 [.36, .54]**
Carrus et al. (2008)	IT	154	41	46	Anticipated affect, specific attitudes, specific injunctive norms, past recycling, specific perceived behavioural control	I	H	.49 [.36, .60]**
Castro, Garrido, Reis, and Menezes (2009)	P	394	29.4	59.5	Specific attitudes, environmental attitudes, facilities, general self-identity	S	H	.21 [.11, .30]**
Chan and Bishop (2013)	AU	271	24	56.8	Specific attitudes, specific injunctive norms, specific perceived behavioural control, specific personal norms	I, S	ST	.42 [.31, .51]**
Chan (1998)	HK	173	NI	67.4	Specific attitudes, specific injunctive norms, specific perceived behavioural control	I, S	H	.35 [.21, .48]**
Chen and Tung (2010)	TW	541	NI	67.3	Specific and environmental attitudes, facilities, specific injunctive norms, specific perceived behavioural control, specific personal norms	I	H	.47 [.40, .53]**
Culiberg (2014)	SLO	367	NI	50.1	Specific attitudes, specific personal norms	I	H	.45[.37, .53]**
D'Amato, Mancinelli, & Zoli (2016)	UK	2009	NI	50.7	Environmental attitudes, bin, facilities, general knowledge	S	H	.16 [.12, .21]**
Daneshvary, Daneshvary, and Schwer (1998)	U.S.	817	47.9	46	Environmental attitudes, past recycling	S	H	.05 [-.02, .12]
Davies, Foxall, and Pallister (2002)	UK	317	NI	57	Anticipated affect, specific attitudes, specific injunctive norms, specific knowledge, past recycling, specific perceived behavioural control, specific personal norms	I, B	H	.13 [.05, .21]**
Davis, Phillips, Read, and Iida (2006)	UK	72	NI	61	Specific and environmental attitudes, past recycling	I	H	.03 [-.20, 26]
De Young (1990)	U.S.	91	NI	NI	Specific attitudes, specific perceived behavioural control, size	S	H	.17 [-.03, .36]

(*continued on next page*)

Table 5 (*continued*)

Author(s)	Country	Total N	Mean age	Gender – % female	Predictors	Operationalization of Recycling	Target group	Effect size& 95% CI
Derksen and Gartrell (1993)	U.S.	1245	41.1	49	Environmental attitudes	S	H	.30 [.25, .35]**
Domina and Koch (2002)	U.S.	472	NI	81	Environmental attitudes, facilities, house type, specific perceived behavioural control	S	H	.21 [.12, .29]**
Ebreo and Vining (2001)	U.S.	63	46	59.4	General knowledge, values	S	H	.35 [.11, .55]**
Elgaaied (2012)	F	276	NI	59	Anticipated affect, environmental attitudes specific perceived behavioural control	I	H	.27 [.16, .38]**
Fielding et al. (2016)	AU	115	NI	66	Specific attitudes, specific descriptive norms, specific perceived behavioural control	S, B	H	.23 [.05, .40]*
Fornara, Carrus, Passafaro, and Bonnes (2011)	IT	452	41.2	50.2	Specific attitudes, specific descriptive norms, specific injunctive norms, specific perceived behavioural control	I	H	.40 [.32, .47]**
Gamba and Oskamp (1994)	U.S.	396	47	59	Specific and environmental attitudes, specific knowledge, ownership, past recycling, specific and general perceived behavioural control	B	H	.09 [-.01, .19]
Green-Demeirs, Pelletier, and Ménard (1997)	CA	444	20.9	73.9	Specific self-identity, specific personal norms	S	ST	.25 [.16, .34]**
Guagnano and Stern (1995)	U.S.	180	42.2	NI	Specific attitudes, bin, specific perceived behavioural control	S	H	.25 [.13, .36]**
Hage et al. (2009)	SE	827	49.6	50	Environmental attitudes, specific descriptive norms, distance, facilities, house type, specific injunctive norms, specific personal norms	S	H	.09 [.02, .16]**
Hansmann, Bernasconi, Smieszek, Loukopoulos, and Scholz (2006)	CH	623	NI	47.4	Specific and environmental attitudes, facilities, specific perceived behavioural control, specific personal norms	S	H	.08 [.00, .16]*
Huffman, van der Werff, & Henning (2014)	U.S.	118	NI	78.7	Specific attitudes, environmental attitudes	B, S	ST	.23 [.05, .40]**
Kalinowski, Lynne, and Johnson (2006)	U.S.	660	46	50	Past recycling, specific perceived behavioural control, specific personal norms	S	H	.21 [.14, .29]**
Knussen and Yule (2008)	UK	252	36	64	Specific attitudes, environmental attitudes, facilities, specific knowledge, specific and general perceived behavioural control	I	H	.25 [.12, .36]**
Knussen, Yule, MacKenzie, and Wells (2004)	UK	239	36.1	64	Specific attitudes, specific injunctive norms, past recycling, perceived behavioural control	I, S	H	.45 [.34, .55]**
Kraft, Rise, Sutton, and Røysamb (2005)	CH	110	24	79.7	Specific attitudes, specific injunctive norms, specific perceived behavioural control	S	ST	.32 [.14, .48]**
Kurz, Linden, and Sheehy (2007)	UK	765	50.6	58.4	Specific attitudes, environmental attitudes	B	H	.12 [.05, .19]**
Lange, Brückner, Kröger, Beller, and Eggert (2014)	DE	282	24.4	62	Distance	I, S	ST	.16 [.05, .28]**
Lee and Paik (2011)	ROK	196	NI	56.9	Specific and environmental attitudes, house type	S	H	.26 [.13, .39]**
Lindsay and Strathman (1997)	U.S.	192	47	71.9	Specific descriptive norms specific and general knowledge, specific perceived behavioural control	S	H	.27 [.13, .40]**
Lüdemann (1999)	DE	183	37.8	66.1	Past recycling, specific injunctive norms, values	S	H	.53 [.41, .63]**
Manika, Wells, Gregory-Smith, and Gentry (2013)	UK	1043	NI	NI	Specific attitudes, general descriptive norms, facilities, general perceived behavioural control	S	E	.17 [.11, .23]**
Mannemar Sønderskov (2011)	UK, USA, DK, SE	3964	45	53	Specific perceived behavioural control, size, values	S	H	.18 [.15, .21]**
Mannetti, Pierro, and Livi (2004)	IT	230	24.4	53.3	Specific attitudes, specific injunctive norms, specific perceived behavioural control	I	ST	.44 [.33, .54]**
Marans and Lee (1993)	TW	608	NI	50.2	Specific attitudes, general descriptive norms specific injunctive norms, specific personal norms, specific knowledge	S	E	.38 [.32, .45]**
McGuinness, Jones, and Cole (1977)	U.S.	132	NI	97.7	Anticipated affect, environmental attitudes, general injunctive norms, specific perceived behavioural control	B	H	.22 [.05, .38]**

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Table 5 (*continued*)

Author(s)	Country	Total N	Mean age	Gender – % female	Predictors	Operationalization of Recycling	Target group	Effect size& 95% CI
Nigbur, Lyons, & Uzzell (1; 2010)	UK	527	NI	61.7	Specific attitudes, specific descriptive norms, specific self-identity, specific injunctive norms, specific perceived behavioural control, specific personal norms	I	H	.59 [.53, .64]**
Nigbur, Lyons, & Uzzell (2; 2010)	UK	264	NI	69.7	Specific attitudes, specific descriptive norms, specific self-identity, specific injunctive norms, specific perceived behavioural control, specific personal norms	I, S	H	.40[.29, .50]**
Ohtomo and Hirose (2007)	JP	206	19.3	67	Specific descriptive norms, environmental attitudes, specific injunctive norms	I, S	ST	.36 [.23, .47]**
Oskamp et al. (1991)	U.S.	221	NI	61	Specific and environmental attitudes, specific and general descriptive norms, specific and general knowledge, house type, ownership, general perceived behavioural control	S	H	.16 [.07, .25]**
Pakpour, Zeidi, Emamjomeh, Asefzadeh, and Pearson (2014)	IR	1782	31.7	63	Specific attitudes, specific injunctive norms, specific perceived behavioural control, specific personal norms, general self-identity, specific knowledge, past recycling	I, S	H	.48 [.45, .52]**
Park and Ha (2014)	U.S.	421	47	51	Specific attitudes, specific injunctive norms, specific perceived behavioural control, specific personal norms	I	H	.72 [.66, .76]**
Pearson et al. (2012)	U.S.	1512	30.3	100	Facilities, specific knowledge, specific perceived behavioural control	S	H	.12 [.07, .17]**
Pensini and Caltabiano (2012)	AU	85	24.2	71.8	Anticipated affect, specific attitudes	S	ST	.33 [.12, .51]**
Rhodes et al. (2015)	CA	176	49.2	61.1	Specific attitudes, distance, specific injunctive norms, specific perceived behavioural control	I, S	H	.38 [.26, .49]**
Robertson and Walkington (2009)	UK	1664	NI	NI	Specific and environmental attitudes, bin, specific descriptive norms, house type, general knowledge	I	ST	.08 [.03, .13]**
Ruepert et al. (2016)	NL, ES, RO, IT	491	43.5	49	General self-identity, general personal norms, values	S	E	.18 [.10, .27]**
Ruepert, Keizer, and Steg (2017)	NL	290	48.2	45	Values	S	E	.27 [.16, .38]**
Schultz & Oskamp (1996)	U.S.	129	NI	66.7	Environmental attitudes	B, S	ST	.19 [-.02, .39]
Schwab, Harton, and Cullum (2014)	U.S.	524	19.2	90.6	Specific attitudes, specific injunctive norms	S	ST	.24 [.16, .31]**
Seacat and Northrup (2010)	U.S.	204	NI	64.5	House type, specific knowledge, specific perceived behavioural control	S	H	.18 [.05, .31]*
Seacat and Northrup (2010)	U.S.	483	NI	71.4	House type, specific knowledge, specific perceived behavioural control	S	H	.16 [.08, .25]**
Segev (2015)	U.S.	410	23.6	57	Environmental attitudes, general knowledge, general perceived behavioural control, general personal norms, values	S	ST	.38 [.29, .46]**
Smith, Haugtvedt, and Petty (1994)	U.S.	198	NI	NI	Anticipated affect, specific attitudes, environmental attitudes	S	ST	.25 [.11, .37]**
Sterner and Bartelings (1999)	SE	456	51.1	351	Specific attitudes, general knowledge, past recycling, specific perceived behavioural control	B	H	.14 [.05, .23]**
Swami, Chamorro-Premuzic, Snelgar, and Furnham (2011)	UK	203	35.5	49.3	Environmental attitudes	S	H	.06 [-.08, .20]
Tabernero et al. (2015)	ES	1501	NI	72.1	Specific perceived behavioural control	S	H	.41 [.37, .45]**
Tang, Chen, and Luo (2011)	CN	756	NI	38	Specific attitudes, environmental attitudes, specific injunctive norms, specific perceived behavioural control, specific personal norms	S	H	.17 [.10, .24]**
Terry, Hogg, and White (1999)	AU	114	32.7	55.9	Specific attitudes, specific descriptive norms, specific self-identity, past recycling, specific perceived behavioural control	I, S	H	.50 [.37, .58]**
Thøgersen (2003)	DK	1955	NI	47	Specific knowledge, specific perceived behavioural control, specific personal norms	S	H	.24 [.20, .28]**
Thøgersen (2009)	DK	200	43	54	Specific injunctive norms, specific personal norms	S	H	.48 [.37, .58]**
Tilikidou and Delistavrou (2008)	GR	420	NI	NI	Specific attitudes, environmental attitudes, general perceived behavioural control	S	H	.35 [.26, .43]**

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Table 5 (*continued*)

Author(s)	Country	Total N	Mean age	Gender – % female	Predictors	Operationalization of Recycling	Target group	Effect size& 95% CI
Tonglet, Phillips, and Read (2004)	UK	191	NI	65	Specific attitudes, environmental attitudes, specific injunctive norms, specific knowledge, past recycling, specific perceived behavioural control, specific personal norms	I, S	H	.27 [.13, .40]**
Unal et al. (2016)	NL	248	38.9	53.4	General self-identity, values	S	E	.37 [.26, .47]**
Van Birgelen, Semeijn, and Keicher (2009)	DE	176	NI	54.5	Specific attitudes, specific perceived behavioural control	S	H	.54 [.42, .63]**
Vining and Ebreo (1990)	U.S.	197	NI	NI	Specific knowledge, facilities	S	H	.17 [.03, .27]*
Vining and Ebreo (1992)	U.S.	203	NI	1986: 41, 1987: 67.3, 1988: 67.4	Environmental attitudes, general knowledge, specific and general personal norms	S	H	.14 [.00, .27]
Wan, Shen, and Yu (2014)	HK	198	NI	47	Specific attitudes, specific injunctive norms, specific personal norms, specific perceived behavioural control	I, S	H	.75 [.68, .80]**
Werner and Makela (1998)	U.S.	116	40.5	NI	Specific attitudes, specific descriptive norms, facilities, specific self-identity, past recycling	S	H	.24 [.02, .43]*
White and Hyde (2012)	AU	148	33.9	56.5	Specific attitudes, specific self-identity, specific injunctive norms, specific perceived behavioural control	I, S	H	.39 [.24, .52]**
White and Hyde (2013)	AU	148	36.3	56.1	Specific injunctive norms, specific perceived behavioural control	S	H	.51 [.38, .62]**
White et al. (1; 2009)	AU	164	35.4	50.6	Specific attitudes, specific descriptive norms, specific injunctive norms, specific perceived behavioural control, specific personal norms	I, S	H	.46 [.33, .58]**
White et al. (2; 2009)	AU	175	33.3	48.6	Specific attitudes, specific descriptive norms, specific injunctive norms, perceived behavioural control, specific personal norms	I	H	.50 [.38, .60]**
Yi, Hartloff, and Meyer (1999)	UK, NL, IT	4113	44.3	NI	Specific attitudes, environmental attitudes, general knowledge	S	H	.29 [.27, .32]**

Note. $^{**}p < .01$, $^{*}p < .05$, Total *N:* Number of participants. Country: Au =Australia; BR = Brazil; CA = Canada; CH = Switzerland; CN = China; DE = Germany; DK = Denmark; ES = Spain; F = France; GR = Greece; HK = Hong Kong; IT = Italy; IR = Iran; JP = Japan; N = Norway; NL = the Netherlands; P = Portugal; RO = Romania; ROK = South Korea; SE = Sweden; SLO = Slovenia; TW = Taiwan; NI = no information. Operationalization of DV: B = Observed recycling behaviour; I = Intention to recycle; S= Self-reported recycling behaviour. Target group: E = Employees; H = Households; ST = Students.

2.3. Data extraction and coding

Two coders were involved in the screening, selection and extraction processes. They first screened all titles and abstracts to select relevant studies. In a second step, full papers of possibly relevant studies were evaluated and a final selection was made in agreement. The two coders performed these steps independently. Inter-rater agreement was high (88.89%). Disagreements were solved through discussion. We further used a standardised coding procedure to abstract the following data from the articles into a coding table: relevant individual factors and their level of specificity (i.e., focusing on recycling in particular, or the environment in general), relevant contextual factors, the operationalization of recycling (i.e., intention, self-reported behaviour or observed behaviour), country in which the study was conducted, target group (i.e., households, students or employees), number and gender of participants, and the statistics needed to calculate the effect sizes. In total, 91 studies met all inclusion criteria and were thus considered to be relevant for this meta-analysis, of which 89 studies reported results on individual factors, while 26 studies reported results on contextual factors. Publication year ranged from 1977 to 2016. Table 5 displays an overview of the studies included, and reports the number of participants, country, mean age, gender distribution, predictors, operationalization of recycling, target group, and effect sizes including 95% confidence intervals for each study.

2.4. Data analyses

We ran the meta-analysis with the program Comprehensive Meta-Analysis version 3 (CMA; Borenstein, Hedges, Higgins, & Rothstein, 2014). As studies were assumed to show between-study variability and within-study variability, we chose to use random-effects models to calculate the overall effect size (Field, 2003; Lipsey & Wilson, 2001; Rosenthal, 1994), which is a more conservative test than fixed-effects models (Hunter & Schmidt, 2004).

We used the correlation coefficient *r* as an index for the effect size as most of the reported studies were correlational. When studies depicted other statistics (e.g., *t*-, *F*-, or X^2-values) we converted them into *r* using Rosenthal's (1994) formulas. For the analyses, the correlations were converted to Fisher's Z metric. For display, we transformed the effects obtained back into correlations. In research involving individual differences, effect sizes of 0.10 are considered to be small, effect sizes of 0.20 as medium, and effect sizes of 0.30 as large (Gignac & Szodorai, 2016). For the individual factors that were measured at the specific as well as at the general level, we report overall effect sizes and effect sizes at the two levels. To compare the effect sizes of the predictors, we calculated the 95% confidence intervals around the effect sizes and examined the extent to which they overlap. We consider effect sizes to be significantly different from each other when the 95% confidence intervals overlap less than half the distance of one side of the confidence interval (Masson & Loftus, 2003).

Some papers included multiple predictors of recycling or multiple indicators of recycling, in which case multiple effect sizes could be extracted for one sample. As these effect sizes are not independent from each other, we pooled all effect sizes from one study to yield an average r. In case multiple effect sizes could be obtained from one study for different moderator analyses, we segregated the effect sizes needed for a particular moderator analysis. This implies that the total number of effect sizes is larger than the number of studies included in this meta-analysis (cf. Van Zomeren, Postmes, & Spears, 2008).

2.5. Testing for heterogeneity

To assess homogeneity across studies, Q and I^2 statistics were calculated for each predictor (Higgins & Green, 2011). The Q statistic is a test of homogeneity across studies. Specifically, it reveals whether effect sizes vary substantially across studies. If heterogeneity is observed across studies, this suggests that moderators may play a role, and that it is worthwhile to explore this. I^2 reveals the ratio of true heterogeneity to total variation in reported studies, and, hence, reveals the proportion of systematic variation that can potentially be explained by moderator variables. For the moderator analysis of operationalization of recycling and target group, we collapsed the results across the specificity level of the individual factors. Hence, for the moderator analysis we did not differentiate between individual factors on a specific and general level. The reason for this was that the number of studies would have been too small for the moderator analyses at each level separately.

2.6. Correction for attenuation

The I^2 -statistic may not only reflect pure between-study variations that can be accounted for by moderators, but may also be affected by artifacts, such as measurement error. If not controlling for measurement error, the estimation of the strength of the moderators may be overestimated. Therefore, we also report correlations corrected for measurement error. For this, we extracted the reliability of measures (Cronbach's alpha) from the primary studies and corrected for measurement error following Hunter and Schmidt (1990). Yet, in our sample, we could only compute the correlation corrected for measurement error in 31% of the cases (Cohen's Alpha was between 0.35 and 0.99). The reason for this was that primary studies either used one-item scales, or did not report the reliability coefficients of the independent variable or the dependent variable. The latter was especially considerable in the case of contextual factors; only one study reported Cronbach's alpha of the measure 'recycling facilities' needed to compute the corrected correlation. For predictors, 9.9% of the missing data was due to one-item scales. For the dependent variables, the percentage of missing data due to one-item scales was higher, namely 37.64%. Consequently, the majority of the analyses including the corrected correlations was based on a limited number of studies (oftentimes less than four), in which case moderator analyses are problematic (Fu et al., 2011; see also; Thompson & Higgins, 2002), indicating that results based on correlations corrected for measurement error should be interpreted with care.

2.7. Publication bias

We report three indices to test publication bias for each predictor variable, collapsing across levels of specificity as we did for the moderator analysis: funnel plot, trim and fill analysis and Rosenthal's fail-safe N. All three approaches have been criticized for different reasons (e.g., Carter, Hilgard, Schönbrodt, & Gervais, 2017; Ioannidis & Trikalinos, 2007; Terrin, Schmid, Lau, & Olkin, 2003), we therefore decided to report all three, and examine if the funnel plot, the trim and fill analysis and Rosenthal's fail-safe N converge on a conclusion. A funnel plot is a test for asymmetry (Egger, Davey Smith, Schneider, & Minder, 1997). This analysis depicts the pattern of the effect size of each study against its standard error. If studies do not scatter systematically around the observed effect size, a publication bias is likely. In the case of publication bias, larger studies typically cluster at the top of the graph in a funnel plot, while smaller studies tend to spread out at the bottom, as smaller studies tend to show more sampling variation. Next, to investigate the adjusted effect size if more non-significant results were included in the analysis, a trim and fill analysis was conducted (Duval & Tweedie, 2000). In this iterative method, the effect sizes are re-computed until effect sizes are distributed systematically. We lastly computed Rosenthal's fail-safe N, which reports the number of studies that would need to be included to make the overall effect size insignificant (Rosenthal, 1991).

3. Results

Tables 1 and 2 display an overview of the effect sizes of all

Table 1
Effect sizes of individual factors.

	r	95% CI		Z	p	ks	ke	N
Anticipated affect								
Specific	.26	.14	.37	4.19	< .001	8	15	1346
Attitudes								
Specific	.34	.29	.39	12.58	< .001	51	108	21,247
General	.19	.15	.23	8.60	< .001	32	82	19,473
Descriptive norm								
Specific	.33	.23	.42	6.18	< .001	13	31	5997
General	.38	.20	.53	3.94	< .001	2	4	2175
Self-identity								
Specific	.48	.34	.59	6.29	< .001	6	9	1613
General	.30	.14	.43	3.68	< .001	5	6	3246
Injunctive norm								
Specific	.33	.27	.38	10.29	< .001	32	67	11,360
General	.21	.13	.29	5.07	< .001	2	3	340
Knowledge								
Specific	.20	.14	.26	6.26	< .001	15	28	9612
General	.21	.15	.29	6.03	< .001	9	20	10,149
Past recycling								
Specific	.41	.25	.54	4.84	< .001	15	24	5497
Perceived behavioural control								
Specific	.39	.32	.44	11.16	< .001	45	80	22,060
General	.18	.10	.26	4.26	< .001	9	13	2985
Personal norm								
Specific	.42	.35	.49	10.367	< .001	23	45	13,079
General	.14	.06	.22	3.27	< .001	3	3	1224
Values								
General	.24	.18	.30	7.53	< .001	8	13	5769

Note. *ks* = number of studies; *ke* = : number of effect sizes.

Table 2

Effect Sizes of Contextual Factors

	r	95% CI		Z	p	ks	ke	N
Contextual Factors								
Housing situation								
House type	.12	.06	.17	4.25	< .001	9	21	47,740
Ownership	.16	.01	.31	2.09	.04	3	4	43,617
Local circumstances								
Possession of bin	.24	.16	.32	5.69	< .001	5	7	4734
Distance	-.11	-.17	-.05	−3.43	< .001	3	10	1285
Facilities	.26	-.09	.55	1.49	.14	12	25	52,121
Size of neighbourhood	-.17	-.35	.02	−1.8	.07	3	4	47,172

Note. *Ks* = number of studies; *ke* = : number of effect sizes.

individual and contextual factors, including the confidence interval, the Z-statistics and the significance level, the number of studies, and participants. Fig. 2 displays a graphical depiction of the uncorrected and corrected correlations. Overall, among the individual factors, particularly recycling self-identity, personal norms towards recycling, past recycling, and perceived behavioural control over recycling were strongly related to recycling. Among the contextual factors, the possession of a recycling bin and house ownership appeared to be strong predictors of recycling. Importantly, the analyses yielded that the confidence intervals around the effect sizes were small, indicating that the assessment was rather robust. Table 3 presents three results of the analyses to assess whether a publication bias is likely. In general, the results of the three indices of publication bias converged on a clear conclusion that in most of the cases publication bias was not an issue, except for some variables (i.e., attitudes, injunctive norms, anticipated affect, and to a lesser extent, recycling facilities and distance to drop off location). In the following, we will discuss the results for each predictor in more detail, again in alphabetical order.

3.1. Effect size individual factors

The results revealed that *anticipated affect* was significantly related to recycling ($r = 0.26$; *kstudies (ks)* = 8; *keffect sizes (ke)* = 15), with a medium effect size. The results of the funnel plot revealed that publication bias may have been present for anticipated affect. This was in line with the results of Rosenthal's fail-safe N that indicated that not that many studies would be needed to render the effect size of anticipated affect non-significant. The trim and fill analysis showed that 4 studies were trimmed for anticipated affect; the adjusted effect sizes would be lower. Yet, the confidence interval of the adjusted effect size substantially overlapped with the confidence interval around the obtained effect size, suggesting that we can be rather confident about the results.

A considerable number of studies examined the effect of specific and general attitudes on recycling. *Specific attitudes* were a relatively strong predictor of recycling ($r = 0.34$; $ks = 51$; $ke = 108$), yielding a large effect size. With a medium effect size, *general attitudes* were significantly less strongly related to recycling ($r = 0.19$; $ks = 32$; $ke = 82$), as reflected in the non-overlapping confidence intervals of specific and general attitudes. The confidence intervals around the effect sizes of specific and general attitudes were small, suggesting that the results were robust. The funnel plot suggested that a publication bias may have been present for attitudes. This was in line with the results of the trim and fill analysis that showed that 23 studies were trimmed. This suggested that if more unpublished studies had been included in this meta-analysis, the effect size for attitudes would have been considerably lower. At the same time, Rosenthal's fail-safe N indicated that relatively many studies would be needed to yield a non-significant effect size.

Specific descriptive norms regarding recycling were relatively strongly related to recycling ($r = 0.33$; $ks = 13$; $ke = 31$), the effect size was large, and confidence interval were relatively small. *General descriptive* norm *regarding pro-environmental behaviour* was one of the strongest predictors at the general level ($r = 0.38$; $ks = 2$; $ke = 4$) with a large effect size. The confidence interval of specific descriptive norms completely overlapped with the confidence interval of general descriptive norms, suggesting that the level of specificity of descriptive norms did not play a big role. Yet, as the confidence interval of general descriptive norms was somewhat large and the number of studies examining general descriptive norms was relatively low, these results should be interpreted with caution. Findings indicated that there was no trace of publication bias.

Relatively few studies examined specific ($ks = 6$; $ke = 9$) and general self-identity ($ks = 5$; $ke = 6$). As a behaviour-specific indicator, *recycling self-identity* was the strongest predictor of recycling ($r = 0.48$) with a small confidence interval. Similarly, *general environmental self-identity* was relatively strongly related to recycling, with a large effect size ($r = 0.30$), but with a large confidence interval. The 95% confidence intervals of recycling self-identity and environmental self-identity substantially overlapped, suggesting that the level of specificity of this variable did hardly affect the strength of the effect size. As can be seen in Table 3, analyses revealed no hint of publication bias for self-identity.

The effect size of *injunctive norms regarding recycling* was strong with a relatively small confidence interval ($r = 0.33$; $ks = 32$; $ke = 67$). The small confidence interval suggested that this result was rather robust. *Injunctive norms towards pro-environmental behaviour* were less strongly related to recycling ($r = 0.21$; $ks = 2$; $ke = 3$), yielding medium effect sizes, but this result should be interpreted with care as the effect size assessment was based on two studies only. The confidence intervals of the specific and general injunctive norms overlapped less than half the distance of one side of the confidence interval, suggesting that injunctive norms regarding recycling were significantly more strongly related to recycling than injunctive norms towards pro-environmental behaviour. With respect to publication bias, results of the funnel plot revealed that publication bias may have be an issue. Similarly, the results of the trim and fill analysis showed that 15 studies were trimmed for injunctive norms, and the adjusted effect sizes would be substantially lower. This suggested that if more unpublished studies had

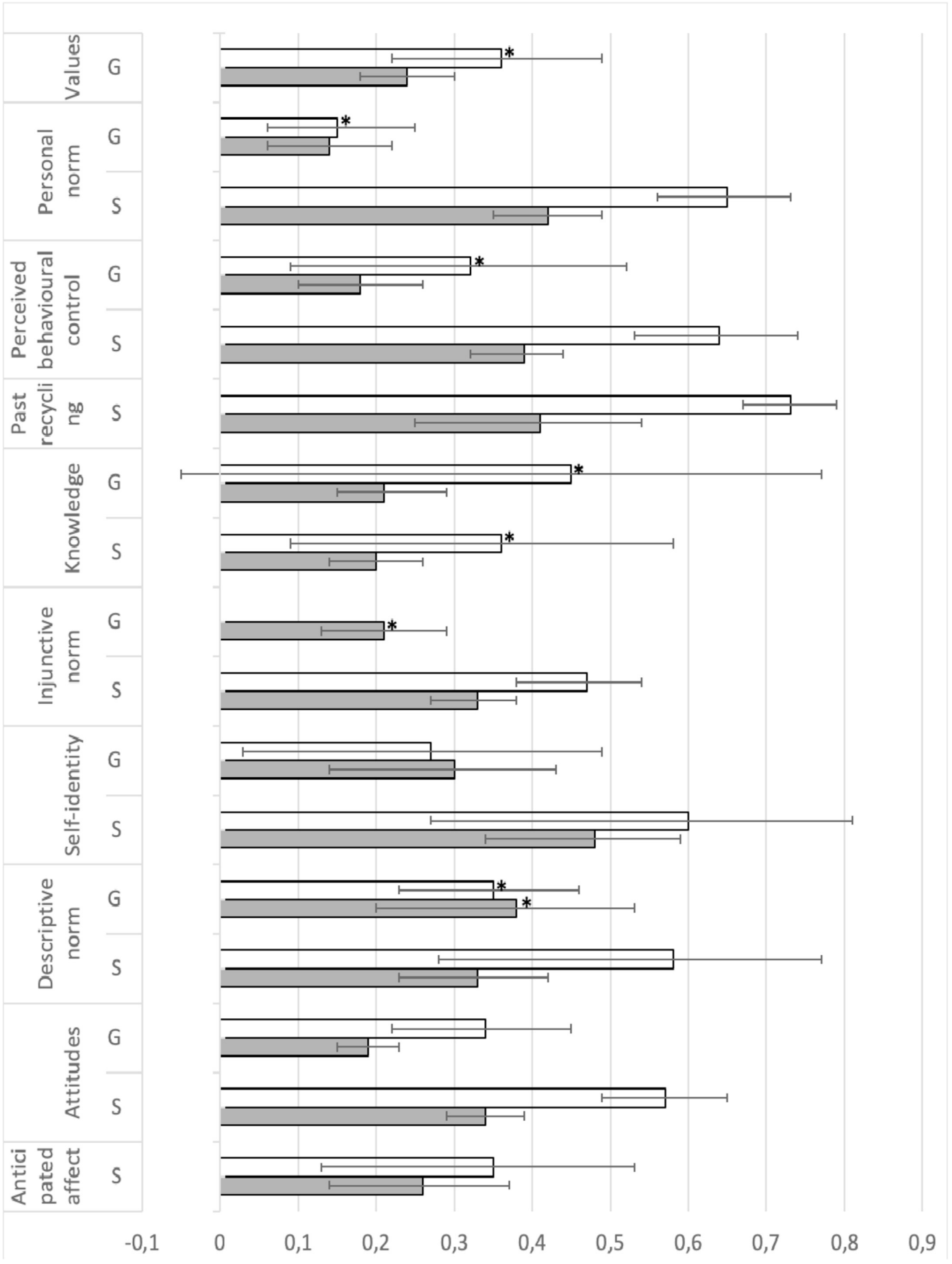

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Fig. 2. Uncorrected correlations (grey) and correlations corrected for measurement error (white).*Note.* Error bars represent 95% confidence interval. S = specific, focusing on recycling; G = general. * Correlations are based on less than 4 studies and should be interpreted with caution. Corrected correlations were not computed for general injunctive norms nor for any of the contextual factors the paper did not report the data to assess the corrected correlations (only one study on recycling facilities reported Cronbach's alpha to calculate the corrected correlations).

Table 3
Summary of results to test publication bias.

	Funnel plot (Egger et al., 1997)	Trim and fill analysis (Duval & Tweedie, 2000)	Adjusted correlation	Fail N Rosenthal, 1991
Individual factors				
Affect	$t(6) = 2.44$*	4	.10; 95% CI [-.03, .23]; Q = 213.49	310
Attitudes	$T(66) = 3.14$**	23	.18; 95% CI [.13, .23]; Q = 5395.54	1423
Descriptive norms	$T(12) = 1.33$, *ns.*	6	.20; 95% CI [.09, .30]; Q = 1286.43	4873
Injunctive norms	$T(31) = 3.42$**	15	.18; 95% CI [.11, .24]; Q = 1793.87	4965
Knowledge	$T(21) = .91$, *ns.*	5	.16; 95% CI [.11, .21]; Q = 680.99	6129
Past recycling	$t(13) = .26$, *ns.*	1	.37; 95% CI [.21, .51]; Q = 1217.16	5296
Perceived behavioural control	$T(50) = .99$, *ns.*	8	.28; 95% CI [.21, .35]; Q = 4415.87	8167
Personal norms	$T(23) = 1.2$, *ns.*	4	.33; 95% CI [.25, .40]; Q = 1622.4	2059
Self-identity	$T(9) = .46$, *ns.*	0	–	2939
Values	$T(6) = .57$, *ns.*	2	.22; 95% CI [.19, .24]; Q = 42.11	556
Contextual factors				
House ownership	$T(1) = .51$, *ns.*	0	–	427
Type of house	$T(7) = 1.33$, *ns.*	0	–	972
Recycling facilities	$T(10) = 3.65$*	0	–	8991
Possession of recycling bin	$T(3) = .56$, *ns.*	0	–	377
Distance to drop-off location	$T(1) = .47$, *ns.*	0	–	32
Size of neighbourhood	$T(1) = .85$, *ns.*	0	–	1802

Note. $^{**}p < .001$; $^{*}p < .05$.

been included in this meta-analysis, the correlations between recycling and injunctive norms would be considerably lower. Yet, Rosenthal's fail-safe N indicated that relatively many studies would be needed to render the effect non-significant.

The results further revealed that *knowledge about recycling* ($r = 0.20$; $ks = 15$; $ke = 28$) and *general knowledge* ($r = 0.21$; $ks = 9$; $ke = 20$) were related to recycling, yielding medium effect sizes. The analysis was based on a considerable number of studies and the confidence intervals of both variables were relatively small, indicating that the assessment was robust. Interestingly, the confidence intervals almost entirely overlapped. This suggested that the level of specificity of knowledge was hardly related to the strength of the effect size. The analysis further revealed that publication bias was unlikely for knowledge.

Past recycling appeared to be one of the predictors that was most strongly related to recycling, with a large effect size ($r = 0.41$; $ks = 15$; $ke = 24$). Past recycling was investigated relatively often and the confidence interval of this variable was relatively small, suggesting that the results were robust. Analysis revealed no hint of publication bias for past behaviour.

Specific perceived behavioural control appeared to be strongly related to recycling ($r = 0.39$; $ks = 45$; $ke = 80$). This result was based on a considerable number of studies. *Perceived behavioural control to engage in pro-environmental behaviour in general* was less strongly related to recycling ($r = 0.18$; $ks = 9$; $ke = 13$), with a small to medium effect size. The confidence intervals of both variables were relatively small and did not overlap, suggesting that the results were robust, and that specific perceived behavioural control was a better predictor of recycling than general perceived behavioural control. In the case of perceived behavioural control, publication bias was unlikely.

Among the behaviour-specific individual factors, *personal norms regarding recycling* appeared to be one of the strongest predictors of recycling ($r = .42$; $ks = 23$; $ke = 45$). A considerable number of studies investigated the relationship between specific personal norms and recycling and the confidence interval was small, indicating that the assessment was robust. *Personal norms to engage in pro-environmental behaviour in general* was relatively weakly related to recycling ($r = .14$; $ks = 3$; $ke = 3$), with small to medium effect sizes, but this result should be interpreted with care as this effects size assessment was only based on three studies. Personal norms towards recycling were more strongly related to recycling than general personal norms, as reflected in the non-overlapping 95% confidence intervals. Findings indicated that there was no trace of publication bias for personal norms to engage in pro-environmental behaviour in general.

Biospheric values and recycling were relatively strongly related ($r = 0.24$; $ks = 8$; $ke = 13$), yielding a medium effect size. The results of the funnel plot, trim and fill analysis and Rosenthal's fail-safe N did not point to a publication bias for values.

3.2. Effect size contextual factors

Regarding the housing situation, the *type of house* ($r = 0.12$; $ks = 9$; $ke = 21$) and *house ownership* ($r = 0.16$; $ks = 3$; $ke = 4$) were both positively related to recycling with small to medium effect sizes. Yet, relatively few studies included these variables, and the confidence intervals around the effect size of both variables were relatively large, suggesting that the assessment of these variables was not very robust. The results of the funnel plot, trim and fill analysis and Rosenthal's fail-safe N did not point to a publication bias of type of house and house ownership.

In the case of local circumstances, *possession of a bin* was relatively strongly related to recycling with a medium effect size ($r = 0.24$; $ks = 5$; $ke = 7$). The number of studies examining this relationship was low. Yet, the confidence interval around the effect size was relatively small, suggesting that the effect size assessment of possession of a bin was rather robust. Publication bias did not seem to be an issue here.

Distance towards a drop-off location was only weakly related to recycling ($r = -.11$; $ks = 3$; $ke = 10$) with a small confidence interval. As the number of studies examining distance to a drop-off location was low, the results should be interpreted with caution. The three indices of publication bias did not converge on a conclusion. Specifically, the results of Rosenthal's fail-safe N indicated that relatively few studies with effect sizes of zero would be needed to yield non-significant effect sizes, whereas the results of the funnel plot and the trim-and fill analyses revealed that publication bias was not an issue.

The effect size of *recycling facilities in place* was strong but not

Table 4
Overview of Correlations and Heterogeneity Test per Predictor (specific and general combined).

	Uncorrected correlations	Q	I^2
Individual factors			
Affect	.26; 95% CI [.14, .37]	88.14**	91.87
Attitudes	.30; 95% CI [.26, .34]	2699.29**	97.52
Descriptive norms	.34; 95% CI [.24, .43]	556.77**	97.67
Injunctive norms	.32; 95% CI [.27, .38]	835.45**	96.17
Knowledge	.21; 95% CI [.17, .25]	360.79**	93.9
Past recycling	.41; 95% CI [.25, .54]	1119.52**	98.75
Perceived behavioural control	.36; 95% CI [.30, .42]	2518.15**	97.98
Personal norms	.40; 95% CI [.33, .47]	1103.72**	97.83
Self-identity	.40; 95% CI [.30, .49]	183.68**	94.56
Values	.24; 95% CI [.18, .30]		
Contextual factors			
House ownership	.12; 95% CI [.06, .17]	30.78**	93.5
Type of house	.16; 95% CI [.01, .31]	110.85**	92.78
Recycling facilities	.24; 95% CI [.16, .32]	17,438.67**	99.94
Possession of recycling bin	.1; 95% CI [.04, .15]	42.58**	90.61
Distance to drop-off location	-.11; 95% CI [-.17, −.05]	6.59*	69.64
Size of neighbourhood	-.17; 95% CI [-.35, .02]	213.57**	99.23

Note. $^{**}p < .0001$; $^{*}p < .05$.

statistically significant ($r = .26$; $ks = 12$; $ke = 25$) as reflected in the confidence interval that includes zero and a nonsignificant Z-statistic. However, the number of studies examining recycling facilities in place was considerable. The results of the analyses of publication bias did not converge on a conclusion whether publication bias was an issue. Specifically, the results of the funnel plot pointed to a publication bias, whereas the results of the trim and fill analysis and Rosenthal's fail-safe N did not do so.

The results of the relationship between *size of neighbourhood* and recycling showed a medium effect size ($r = -.17$; $ks = 3$; $ke = 4$). Yet, the result was only marginally significant, as reflected in the significance level of Z-statistics ($p = .07$) and in the confidence interval which had a higher bound of 0.02. The number of studies included in this analysis was low and the confidence interval relatively large. Hence, this result should be interpreted with care. Publication bias did not seem to be an issue for size of neighbourhood.

3.3. Moderator analyses

As can be seen in Table 4, for all relationships, the Q statistics were significant, and the I^2 statistics suggest that the proportion of systematic variation that can potentially be explained by moderator variables was high. This indicated that moderators may have played a role, and that it was worthwhile to explore this. As indicated earlier, for the moderator analyses reported below, we did not differentiate between the specific and general conceptualisation of the predictors.

We first tested the influence of the conceptualisation of recycling as a moderator. As expected, the predictors were more strongly related to the intention to recycle ($r = 0.41$; 95% CI [0.34; 0.48]; $ks = 30$; $ke = 182$) than to self-reported recycling behaviour ($r = 0.28$; 95% CI [0.25; 0.30]; $ks = 70$; $ke = 396$) and particularly than to observed recycling behaviour ($r = 0.13$; 95% CI [0.09; 0.17]; $ks = 9$; $ke = 50$; $Q(2) = 165.67$, $p < .001$). This suggested that the individual and contextual factors better explain intention to recycle than self-reported recycling behaviour, and particularly better than observed recycling behaviour. We next compared the confidence intervals around all predictors for different conceptualisations of recycling. Fig. 3 shows that the 95% confidence intervals around intention to recycle, self-reported recycling behaviour, and observed recycling behaviour did not overlap for attitudes, perceived behavioural control, and personal norms suggesting that attitudes, perceived behavioural control and personal norms could better predict intention to recycle than self-reported recycling behaviour and particularly compared to observed recycling behaviour. In a similar vein, anticipated affect could better predict intention to recycle than self-reported behaviour, but not better than observed recycling behaviour, as reflected in the 95% confidence intervals that did not overlap. Interestingly, descriptive norms, self-identity and past behaviour did not seem to better explain intention to recycle than self-reported recycling behaviour. No studies looked at the relationship of descriptive norms nor self-identity and observed behaviour; less than four studies did this for past behaviour. The results showed that past behaviour could predict recycling intention better than observed behaviour, while the relationship between past behaviour and self-reported recycling and past behaviour and observed recycling behaviour did not seem to differ. This result was similar to the one of injunctive norms: intentions could be better explained than self-reported and observed recycling behaviour whereas the confidence intervals of self-reported and observed recycling behaviour overlapped. Furthermore, the results suggested that knowledge and values could better explain self-reported recycling behaviour than intention to recycle. This counterintuitive finding may have been due to the small number of studies that examined self-reported recycling behaviour (less than 4), hence these results should be interpreted with caution. To sum up, the majority of predictors were most strongly related to intentions, and less to self-reported and observed behaviour.

When we examined whether the obtained effect sizes for contextual factors depended on the operationalization of recycling, the results were not conclusive (see Fig. 4). This is due to the limited number of studies examining the relationships between contextual factors and recycling. Notably, for none of the predictors, all three operationalizations of recycling were assessed. Furthermore, only in the cases of self-reported recycling behaviour and type of house, recycling facilities, and possession of recycling bin, the analysis was based on more than four studies. All of the 95% confidence intervals overlapped. Hence, based on the data available, no firm conclusions can be drawn on whether contextual factors better predict intentions to recycle than self-reported recycling and observed recycling behaviour.

The second moderator, namely, the target group, did not emerge as a significant moderator variable: $Q(2) = 1.40$, $p = .50$, indicating that effect sizes were similar for households, students, and employees in organisations ($r_{households} = 0.30$; 95% CI [0.27; 0.33]; $ks = 70$; $ke = 526$; $r_{students} = 0.26$; 95% CI [0.19; 0.33]; $ks = 16$; $ke = 86$; $r_{employees} = .27$; 95% CI [0.17; 0.37]; $ks = 5$; $ke = 16$). This means that similar individual and contextual factors underlain the recycling of households, students and employees. As this moderator variable appeared to be non-significant at the general level, we did not run additional analysis for each predictor separately.

3.4. Correlations corrected for measurement error

When correcting for measurement error, effect sizes were generally larger, increasing between 0.01 for general personal norms to 0.32 for past recycling behaviour (see Fig. 2 for an overview of the uncorrected and corrected correlations). Yet, many corrected correlations, including the one of general self-identity, were based on a very small number of studies and should therefore be interpreted with caution. This was also reflected in the confidence intervals of the corrected correlations: they were much wider than the confidence intervals of the uncorrected correlations, indicating that we could be less confident about the effect sizes assessed. Yet, the overall pattern of the results was similar to the pattern of the results of the uncorrected correlations, again showing that recycling self-identity, past recycling behaviour and personal norms towards recycling were most strongly related to recycling, while attitudes towards the environment, personal norms towards pro-environmental behaviour and recycling and environmental knowledge were relatively weakly related to recycling.

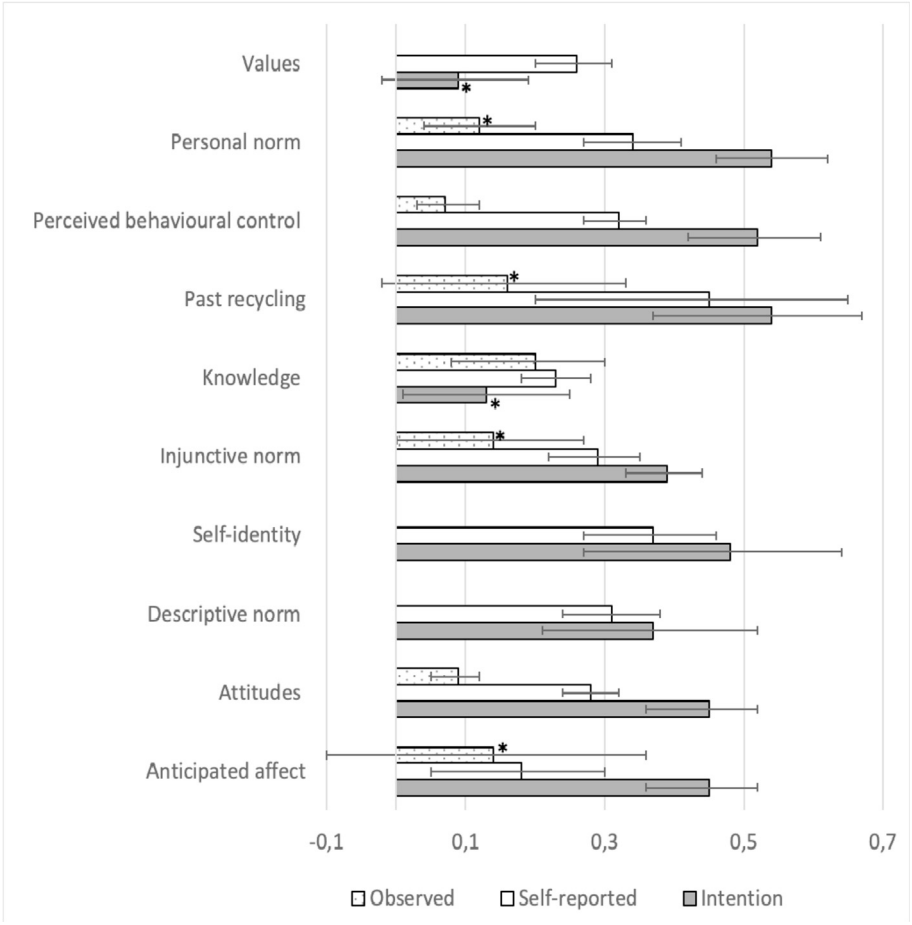

Fig. 3. Uncorrected correlations of individual factors for intention to recycle (grey), self-reported (white) and observed recycling behaviour (dotted). *Note.* Error bars represent 95% confidence interval. * Correlations are based on less than 4 studies and should be interpreted with caution. No studies examined correlations between observed recycling behaviour and descriptive norm, self-identity and values, respectively, so these do not appear in the Figure.

4. Discussion

The aim of the current meta-analysis was to examine the extent to which different individual and contextual factors predict recycling across studies. Furthermore, we aimed to investigate if the operationalisation of recycling and the target group studied influence the strength of these relationships. Overall, the results revealed that individual as well as contextual factors were related to recycling, with

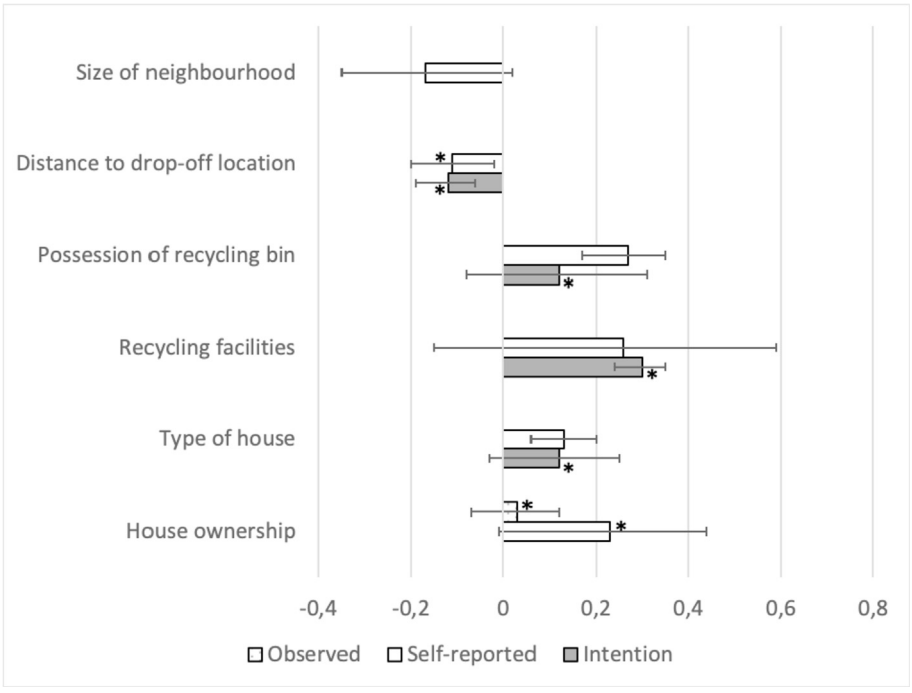

Fig. 4. Uncorrected correlations of contextual factors for intention to recycle (grey), self-reported (white) and observed recycling behaviour (dotted). *Note.* Error bars represent 95% confidence interval. * Correlations are based on less than 4 studies and should be interpreted with caution. No studies examined correlations between intention to recycle and house ownership and size of neighbourhood; between observed recycling and type of house, recycling facilities, possession of recycling bin, distance to drop-off location and size of neighbourhood, respectively, so these do not appear in the Figure.

effect sizes ranging from small (e.g. for type of house) to large (e.g. for recycling self-identity and personal norms towards recycling). Furthermore, the confidence intervals around the effect sizes were small, suggesting that we can be confident about the effect sizes reported. This conclusion was further supported by the finding that except for the variables anticipated affect, attitudes and injunctive norms, no indication of publication biases was found.

4.1. Specific individual factors

Consistent with the compatibility principle (Ajzen, 1996), the results of the meta-analysis indicated that behaviour-specific individual factors, such as attitudes towards recycling, are better predictors of recycling than general predictors, such as environmental attitudes; behaviour-specific factors were also more studied than general factors. More precisely, our findings indicate that one's recycling self-identity is most strongly related to recycling: individuals seeing themselves as a person who recycles are more likely to recycle. Recycling self-identity is likely to encourage recycling, as individuals are motivated to act upon how they see themselves in order to be consistent (cf. Dietz et al., 2005). Next, our findings show that one's past recycling behaviour is strongly related to recycling. This may indicate that recycling is habitual. Yet, previous recycling may also affect recycling via a different process. Past recycling may influence how people see themselves, hence strengthening the recycling self-identity, and in turn affecting recycling. Indeed, research suggests that environmental self-identity is strengthened when people are reminded of their past pro-environmental behaviour, which in turn promotes other pro-environmental actions (Van der Werff, Steg, & Keizer, 2014). Future research is needed to explore why previous recycling affects current recycling, and particularly consider the role of habits and recycling self-identity in this process.

Our results further suggest that both personal and social (descriptive and injunctive) norms towards recycling are positively related to recycling, all showing large effect sizes: people are more likely to recycle when they feel morally obliged to recycle, when they think others do so as well and when they believe others to approve recycling. Furthermore, a relatively strong relationship between perceived behavioural control over recycling and recycling was observed. This is in line with the results of the meta-analysis by Bamberg and Möser (2007), showing that the intention to engage in pro-environmental behaviour in general is stronger if the perceived ability to perform this behaviour is higher. The current meta-analysis adds to these findings that perceived behavioural control is also strongly related to recycling as a specific type of pro-environmental behaviour. Attitudes towards recycling also held large effect sizes. This is consistent with literature showing that individuals who evaluate a particular behaviour more favourably are more likely to engage in this behaviour (cf. Ajzen, 1991). Based on the findings of this meta-analysis, we showed that this finding also applies to recycling: individuals evaluating recycling more favourably are more likely to recycle their waste.

Anticipated affect was related to recycling as well: people were more likely to recycle if they anticipated this would yield positive feelings, or if they anticipated that not recycling would elicit negative feelings. This finding highlights the fact that besides cognitive factors, emotional factors are also important to consider as predictors of recycling (Haidt, 2001; Zajonc, 1980). Interestingly, knowledge about how to recycle was less strongly related to recycling than motivational factors. Other studies also revealed that knowledge is less predictive of environmental behaviour than motivational factors (e.g., Hornsey, Harris, Bain, & Fielding, 2016; Schultz, 1999; Ünal, Steg, & Gorsira, 2018). Some authors have argued that knowledge may particularly affect behaviour when people are motivated to engage in the behaviour in the first place, suggesting an interaction effect between knowledge and motivational factors (Bolderdijk, Gorsira, Keizer, & Steg, 2013). Future studies are needed to examine whether knowledge particularly affects recycling among those who are strongly motivated to recycle.

4.2. General individual factors

Our results further suggest that all general individual factors were related to recycling. Interestingly, the overall pattern of these results was comparable to those of individual factors that were assessed at the specific level. Yet, the relationships were generally weaker. A stronger environmental self-identity appeared to be related to more recycling. This finding is in line with previous research revealing that environmental self-identity is an important predictor of a wide range of pro-environmental behaviours (Van Der Werff et al., 2013a; Van Der Werff et al., 2013b; Whitmarsh & O'Neill, 2010), among which recycling (e.g., Gatersleben, Murtagh, & Abrahamse, 2014; Nigbur et al., 2010; Peters, van der Werff, & Steg, 2018). Biospheric values were also positively related to recycling behaviour. This finding is in line with previous studies that generally showed that the more individuals endorse biospheric values, the more likely they are to engage in pro-environmental behaviour such as recycling (De Groot & Steg, 2007, 2008). In line with the results of the specific individual factors, descriptive norms as well as injunctive norms towards pro-environmental behaviours in general are related to recycling, with a medium effect size. The more people think others act pro-environmentally or others expect them to act pro-environmentally, the higher the likelihood that they recycle their waste. However, the results on the relationships between recycling and general descriptive and injunctive norms should be interpreted with care, as these results were only based on two studies each. Knowledge about environmental problems and general environmental attitudes were also related to recycling behaviour, indicating that individuals who are knowledgeable about the causes and consequences of environmental problems and are concerned about the environment are more likely to recycle, yielding a medium effect size. Furthermore, the more individuals feel able to engage in pro-environmental behaviour in general, the more likely they are to recycle. Interestingly, personal norms to engage in pro-environmental behaviour were only weakly related to recycling. This implies that individuals who feel morally obliged to engage in pro-environmental behaviour in general are only slightly more likely to also engage in recycling. Again, these results should be interpreted with caution as only three studies investigated this relationship.

4.3. Contextual factors

Our meta-analysis further showed that contextual factors are consistently related to recycling. More precisely, this meta-analysis revealed that the possession of a recycling bin is relatively strongly related to more recycling, whereas the size of the neighbourhood and the distance to a drop-off location were less strongly related to recycling. Furthermore, the recycling facilities in place were not significantly related to recycling. House ownership and house type were relatively weakly related to recycling, with a small to medium effect size, suggesting that these factors are less relevant for recycling. Specifically, people owning a house are somewhat more likely to recycle than those renting a house. People living in a single-family house are somewhat more likely to recycle compared to people living in an apartment. Yet, the number of studies including these contextual factors was low and the confidence interval of the effect sizes for indicators of local circumstances were relatively large, suggesting that we can be less confident about the effect sizes for contextual factors.

4.4. Moderator analysis

We found that attitudes, perceived behavioural control, personal norms and injunctive norms better predicted intention to recycle than self-reported recycling behaviour, and particularly compared to observed recycling behaviour. Furthermore, anticipated affect could better predict intentions to recycle than self-reported recycling behaviour and past behaviour was more strongly related to intentions to

recycle than to observed recycling behaviour. This may point to an intention-behaviour gap suggesting that motivation is more likely to strengthen intentions than promoting actual behaviour (Kollmuss & Agyeman, 2002). This suggests that future research should clearly distinguish between the different outcome variables as this may lead to different results. Moreover, it shows that it is important to not only study intentions to recycle and self-reported recycling behaviour; it seems essential to study actual behaviour as well. In line with this, future studies could examine why the individual factors better predict intentions than behaviour. Specifically, which factors deter individuals who have (strong) intentions to recycle from engaging in this behaviour? May self-reported recycling reflect recall problems that people face when filling in a questionnaire? The results of the moderator analysis of the operationalization of recycling for contextual factors was inconclusive due the limited number of studies investigating contextual factors. Future studies should more systematically investigate the influence of contextual factors on different indicators of recycling and examine whether these can better explain intention to recycle than self-reported or observed recycling behaviour.

Interestingly, our findings suggest that the relationships between individual and contextual factors on the one hand and recycling on the other hand, did not differ across different target groups. Notably, we found that similar factors influence the recycling of households, students, and employees in organisations. This is an important finding, suggesting that similar strategies can be employed to promote recycling across different target groups; we come back to the practical implications of these findings below. Interestingly, our results differ from previous research that has suggested that different factors may play a role in explaining pro-environmental behaviour for different target groups (e.g., students versus households; Abrahamse & Steg, 2013; Lokhorst, Werner, Staats, van Dijk, & Gale, 2011). These studies, however, examined different types of pro-environmental behaviours whereas we investigated recycling in particular. Future research is needed to examine under which conditions different factors underlie behaviour of different target groups, and why this may be the case.

4.5. Theoretical implications and future research

The current meta-analysis revealed that both individual and contextual factors are important predictors of recycling. Most of the individual factors included in this meta-analysis have been included in theories to explain environmental behaviour, such as the Theory of Planned Behaviour (Ajzen, 1991), the Norm-Activation-Model (Schwartz & Howard, 1981), or the Value-Belief-Norm theory on environmentalism (Stern, 2000), but only few studies tested these theories explicitly. In fact, some studies on recycling were based on the Theory of Planned Behaviour (Ajzen, 1991). This theory proposes that behaviour is influenced by intentions, and that intentions in turn depend on attitudes, perceived behavioural control, and subjective norms (similar to injunctive norms). Our meta-analysis shows that the variables included in the Theory of Planned Behaviour are rather strongly related to recycling. Yet, importantly, this meta-analysis suggests that recycling not only depends on individual and social costs and benefits considerations, as reflected in attitudes and social norms towards recycling and perceived behaviour control, but also on moral and environmental costs and benefits, as reflected in environmental self-identity, values and personal norms. This is in line with other research showing that pro-environmental behaviour is not primarily motived by individual costs and benefits, but that normative and environmental concerns play a key role (e.g., Steg, Bolderdijk, Keizer, & Perlaviciute, 2014; Steg, Perlaviciute, & van der Werff, 2015; Whitehead & Cherry, 2007). In line with this, the Norm Activation Theory (Schwartz & Howard, 1981), the Value-Belief-Norm theory of environmentalism (Stern, 2000) and the Value-Identity-Personal norm model (Ruepert et al., 2016; Van der Werff & Steg, 2016) may be relevant when explaining recycling. These theories have in common that they focus on normative or moral considerations. Specifically, all three theories propose that personal norms influence pro-environmental behaviour, but they include different antecedents of personal norms. Importantly, the results of the current meta-analysis suggest that variables from different theoretical frameworks such as recycling self-identity (Value-Identity-Personal norm model), personal norms towards recycling (Norm Activation Theory, Value-Belief-Norm theory of environmentalism, Value-Identity-Personal norm model), and perceived behavioural control over recycling (Theory of Planned Behaviour), seem most relevant in explaining recycling. This suggests that an integrated approach involving different theoretical frameworks may be needed to better explain recycling.

To be able to test the predictive power of different theories across studies, it would be important to also examine the relationships between predictors of recycling. Yet, only a few studies included in our meta-analysis reported data on correlations between predictors. Hence, it was not possible to test casual relationships between predictors included in the current meta-analysis. Exploring relationships between predictor variables would shed some light on why some predictors were relatively weakly and others more strongly related to recycling. For instance, biospheric values were moderately strongly related to recycling. One explanation for this result may be that biospheric values, as relatively stable and general guiding principles for choices and behaviours, are likely to influence recycling indirectly via behaviour-specific factors such as personal norms (cf. Ruepert et al., 2016; Stern, 2000; Van der Werff & Steg, 2016). These findings point to several avenues for future research. Although key variables of the models discussed above have been included in studies on recycling, not all variables from relevant theories have been included in studies on recycling. For example, outcome efficacy that is a key variable in the Norm-Activation Model and Value-Belief-Norm theory has not been included in studies on recycling. Moreover, the full models have hardly been tested in one study, and as a consequence, it is not possible to test whether the theoretical models are supported. Future studies could include key variables from different theories, as to examine to what extent and under which conditions the Theory of Planned Behaviour versus theories focusing on normative considerations (Norm Activation Theory, Value-Belief-Norm theory, Value-Identity-Personal norm model) are most predictive of recycling. This may reveal under which conditions not only individual factors but also whole theories, such as these discussed above, can predict recycling.

As yet, only a few studies have investigated the influence of contextual factors on recycling. The results of this meta-analysis suggest that considering contextual factors may be crucial. Future studies are needed to examine the relationship between contextual factors and recycling more systematically to ascertain the magnitude and consistency of these relationships. Our findings on contextual factors point to several avenues for future research. First, future studies could more systematically investigate how different contextual factors affect recycling, and explore other proxies of quality of recycling facilities. A recent meta-analysis supports the notion that interventions should consider the context in which recycling takes place as environmental alterations were among the strongest interventions to promote recycling (Varotto & Spagnolli, 2017). Second, most studies examined the relationship of individual factors and contextual factors on recycling independently. Future research could examine to what extent contextual factors are related to individual factors, and whether both interact. For example, contextual factors may affect recycling via individual factors, for instance, via perceived behavioural control and attitudes. That is, people may feel more able to recycle and have more favourable attitudes to recycle when better recycling facilities are offered. Next, future research can study the interaction between individual and contextual factors, which will reveal under which conditions individual and contextual factors affect recycling. For example, very convenient recycling facilities may particularly affect recycling among those who do not evaluate recycling very favourably. Hence,

contextual factors that make recycling more convenient can particularly encourage recycling among those who hold a less favourable attitude towards recycling who would otherwise not recycle. In line with the ABC theory (Stern, 2000), when contextual factors are less likely to favour recycling, individual factors may have a stronger influence on whether one engages in recycling. Specifically, a person with a very favourable attitude towards recycling may even recycle when contextual factors are not very favourable. The interplay between individual and contextual factors has hardly been studied, with a few exceptions (Best & Kneip, 2011; Tabernero, Hernández, Cuadrado, Luque, & Pereira, 2015; Vining & Ebreo, 1992). Future studies are needed to examine the interplay between individual and contextual factors and its relationship with recycling.

4.6. Limitations

A limitation of the current meta-analysis is that the correlations corrected for measurement error were only based on a very small number of studies, as many studies did not report reliabilities. These results should therefore be interpreted with caution. Future studies on recycling should systematically report reliabilities as well as means and standard deviations of scales to ensure that future meta-analyses can better correct for artifacts. Interestingly, we noticed a trend that particularly papers published before the 2000's did not report these measures, suggesting a development towards reporting reliabilities, means and standard deviations of scales has taken place in the last 20 years.[1]

4.7. Practical implications

Our meta-analysis suggests that both individual and contextual factors can be targeted to promote recycling. Interventions to promote recycling will be particularly effective if they target the most predictive individual and contextual factors of recycling. This meta-analysis indicates that interventions could best target recycling- and environmental-self-identity, past recycling behaviour, attitudes towards recycling, personal norms towards recycling, perceived behavioural control over recycling, and among contextual factors, the possession of a recycling bin. Various strategies could be employed in this respect. Regarding the contextual factors, recycling facilities and collection systems could be made more convenient and more easily accessible. For example, the frequency of collection could be increased, and recycling facilities could be placed closer to one's home (e.g., kerbside collection systems, or better storage facilities in one's home). Improving recycling facilities may not only affect behaviour directly, but also indirectly by strengthening attitudes or perceived behaviour control to recycle by making recycling more feasible and attractive. In addition to the contextual factors included in this meta-analysis, other strategies could be employed such as providing incentives or rewards for recycling or fines for not disposing recyclables correctly. This may, in turn, affect attitudes in a positive way, which appeared to be a strong predictor of recycling. Financial incentives, for example, seemed to be relatively effective in stimulating recycling as long as they are in place. However, it is not clear why financial incentives may particularly work to stimulate recycling (Maki, Burns, Ha, & Rothman, 2016).

Various strategies can be employed that target the motivational factors enhancing recycling. For example, feedback can be provided on one's recycling performance, as to make people aware of their 'good' behaviour. This may strengthen their recycling self-identity, as well as their environmental self-identity in general, which in turn may encourage them to recycle more (Van der Werff et al., 2014) and to engage in other pro-environmental behaviours (Van der Werff et al., 2014).

Furthermore, social modelling can be employed: behavioural models can demonstrate the desired behaviour, in this case recycling. Such social models can strengthen descriptive norms to recycle, and enhance perceived behaviour control when people perceive concrete guidelines on how to recycle. Similarly, information can be provided on the extent to which others recycle, about one's own recycling in comparison to others, or that others expect a person to recycle, which is likely to strengthen descriptive and injunctive norms to recycle (Abrahamse & Steg, 2013). Alternatively, the negative impact of poor waste recycling can be emphasised, which is likely to increase people's awareness of the problems and affect recycling attitudes positively, and may also strengthen personal norms to recycle (Steg, Dreijerink, & Abrahamse, 2005; Stern, Dietz, Abel, Guagnano, & Kalof, 1999). Future research is needed to test whether the strategies discussed above are indeed effective in promoting recycling, and via which processes they do so, notably whether the strategies indeed target the motivational and contextual antecedents in the way we proposed. The latter is pivotal to enhance theory and practice on ways to promote recycling.

Interestingly, the meta-analysis suggests that there is no need to tailor interventions to different targets groups, notably for households, students and employees. Similar factors seem to underlie the recycling of these groups. This implies that the behaviour-change strategies identified above can be implemented on a large scale, thereby targeting and motivating various groups in society to recycle. By identifying important and consistent individual and contextual factors related to recycling, our meta-analysis provides important guidelines of which variables could best be targeted in future research and in policies, as for example of the European Union and the Worldbank, aiming at increasing recycling rates.

4.8. Conclusion

The current meta-analysis aimed to identify the most robust and important predictors of recycling across studies. Individual as well as contextual factors appeared to be significantly related to recycling. Among these, recycling self-identity, past recycling, perceived behavioural control over recycling, personal, descriptive and injunctive norms towards recycling and the possession of a bin are most strongly related to recycling. Behaviour-specific factors are generally better predictors of recycling than general factors. Further, the operationalization of recycling is critical: individual and contextual factors can better predict intention to recycle than self-reported recycling behaviour, and particularly compared to observed recycling behaviour.

[1] There are two issues that we would like to raise concerning the interpretation and the practical implications of corrected correlations. First, when there is no or only a small effect in the population, the corrected correlations are likely to overestimate the effect size, with the overestimation becoming stronger the lower the reliability coefficient is (Hunter & Schmidt, 1990; Murphy, 2003; Zhao, 2017). In a similar vein, there is evidence to suggest that there is no difference between the uncorrected and corrected correlations comparing it to real-world data (Zhao, 2017; also see the discussion on correcting for artifacts by Murphy, 2003). Second, correcting for measurement errors assumes that concepts can be measured in a perfect way, while this is hardly ever the case in practice. In case of low alpha's, many studies are needed to assess the effect in an adequate way and confidence intervals are likely to be relatively large. This suggests that one should be careful with overestimating the value of correlations corrected for measurement error as the interpretation and the practical implications can be debated.

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